

## PATENT COOPERATION TREATY

PCT

## NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents  
United States Patent and Trademark  
Office  
Box PCT  
Washington, D.C.20231  
ÉTATS-UNIS D'AMÉRIQUE

in its capacity as elected Office

Date of mailing (day/month/year)

09 December 1999 (09.12.99)

International application No.

PCT/EP99/02424

Applicant's or agent's file reference

BET 018 WO

International filing date (day/month/year)

09 April 1999 (09.04.99)

Priority date (day/month/year)

09 April 1998 (09.04.98)

Applicant

HEICHLER, Johannes et al

1. The designated Office is hereby notified of its election made:



in the demand filed with the International Preliminary Examining Authority on:

09 November 1999 (09.11.99)



in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was

was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO  
34, chemin des Colombettes  
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

Sean Taylor

Telephone No.: (41-22) 338.83.38

## PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>BET 018 WO</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/EP 99/ 02424</b>	International filing date (day/month/year) <b>09/04/1999</b>	(Earliest) Priority Date (day/month/year) <b>09/04/1998</b>
Applicant <b>BETARESEARCH et al.</b>		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.



It is also accompanied by a copy of each prior art document cited in this report.

**1. Basis of the report**

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.



the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :



contained in the international application in written form.



filed together with the international application in computer readable form.



furnished subsequently to this Authority in written form.



furnished subsequently to this Authority in computer readable form.



the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.



the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,



the text is approved as submitted by the applicant.



the text has been established by this Authority to read as follows:

**BIDIRECTIONAL BROADCASTING SYSTEM**

5. With regard to the **abstract**,



the text is approved as submitted by the applicant.



the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.



as suggested by the applicant.



because the applicant failed to suggest a figure.



because this figure better characterizes the invention.

1



None of the figures.

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 99/02424

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 H04H1/00 H04H9/00 H04N7/173

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 H04H H04Q H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P, X	EP 0 851 618 A (TEXAS INSTRUMENTS INC) 1 July 1998 (1998-07-01) abstract column 5, line 42 - line 55 column 6, line 11 - line 14 column 7, line 34 - column 47 claims 7,9 figures 3-6	1,7,9, 10,12
X	EP 0 713 347 A (AT & T CORP) 22 May 1996 (1996-05-22) abstract column 3, line 49 - column 4, line 7 column 14, line 11 - column 52 claim 1	1,7
A	figures 1-4	2,3



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

## ° Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

24 August 1999

Date of mailing of the international search report

01/09/1999

Name and mailing address of the ISA

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Authorized officer

Simon, V

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 99/02424

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 97 48196 A (BELLSOUTH CORP) 18 December 1997 (1997-12-18) abstract page 8, line 24 - line 27 page 11, line 9 - line 16 page 12, line 2 - line 9 claims 1,6 figures 1,3-5 ---	12,14
A	---	1,7,11
A	WO 97 48191 A (BUGAS DMITRY ;GRAVES H DAVID (CA); BROADBAND NETWORKS INC (CA); SC) 18 December 1997 (1997-12-18) abstract page 20, line 20 - line 35 claim 33 figures 1-3,6 ---	1-3,7, 11,12
A	WO 97 21276 A (STANFORD TELECOMM INC) 12 June 1997 (1997-06-12) abstract claim 1 page 9, line 3 - page 10, line 8 page 37, line 19 - page 40, line 28 figures 1,17-21 ---	1,5,7
A	EP 0 825 775 A (PHILIPS ELECTRONICS NV) 25 February 1998 (1998-02-25) abstract column 3, line 32 - line 48 -----	12,13

## INTERNATIONAL SEARCH REPORT

Information on patent family members

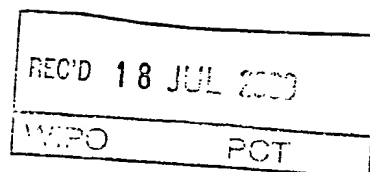
International Application No

PCT/EP 99/02424

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0851618	A	01-07-1998	JP 10200473 A	31-07-1998
EP 0713347	A	22-05-1996	US 5570355 A	29-10-1996
			CA 2162611 A	18-05-1996
			CN 1151094 A	04-06-1997
			JP 8251237 A	27-09-1996
WO 9748196	A	18-12-1997	US 5867485 A	02-02-1999
			AU 3482497 A	07-01-1998
			CA 2257978 A	18-12-1997
			EP 0906672 A	07-04-1999
WO 9748191	A	18-12-1997	AU 3021997 A	07-01-1998
			CA 2257967 A	18-12-1997
			EP 0904639 A	31-03-1999
WO 9721276	A	12-06-1997	US 5809431 A	15-09-1998
			AU 1078197 A	27-06-1997
			BR 9611926 A	30-03-1999
			CA 2237463 A	12-06-1997
			CN 1214815 A	21-04-1999
			EP 0873594 A	28-10-1998
EP 0825775	A	25-02-1998	FR 2752502 A	20-02-1998
			JP 10093888 A	10-04-1998

## PATENT COOPERATION TREATY

## PCT



## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

16

Applicant's or agent's file reference <b>BET 018 WO</b>		<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. <b>PCT/EP99/02424</b>	International filing date (day/month/year) <b>09/04/1999</b>	Priority date (day/month/year) <b>09/04/1998</b>	
International Patent Classification (IPC) or national classification and IPC <b>H04H1/00</b>			
Applicant <b>BETARESEARCH et al.</b>			

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 7 sheets, including this cover sheet.

- ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 5 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☒ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☒ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand <b>09/11/1999</b>	Date of completion of this report <b>13.07.2000</b>
Name and mailing address of the international preliminary examining authority:  <b>European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465</b>	Authorized officer <b>Pajatakis, E</b> Telephone No. <b>+49 89 2399 8898</b> 

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/EP99/02424

**I. Basis of the report**

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

**Description, pages:**

1-16 as originally filed

**Claims, No.:**

1-17 as received on 08/06/2000 with letter of 08/06/2000

**Drawings, sheets:**

1/13-13/13 as originally filed

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:  
☐ the claims, Nos.:  
☐ the drawings, sheets:

3. ☒ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

**see separate sheet**

4. Additional observations, if necessary:

**III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability**

The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

- ☐ the entire international application.  
☒ claims Nos. 12-17.

because:

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/EP99/02424

- ☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (*specify*):

- ☒ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. 12-17 are so unclear that no meaningful opinion could be formed (*specify*):

**see separate sheet**

- ☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.
- ☐ no international search report has been established for the said claims Nos. .

**IV. Lack of unity of invention**

1. In response to the invitation to restrict or pay additional fees the applicant has:

- ☒ restricted the claims.
- ☐ paid additional fees.
- ☐ paid additional fees under protest.
- ☐ neither restricted nor paid additional fees.

2. ☐ This Authority found that the requirement of unity of invention is not complied and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

- ☐ complied with.
- ☒ not complied with for the following reasons:

**see separate sheet**

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

- ☐ all parts.
- ☒ the parts relating to claims Nos. 1-6,12-17.



**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/EP99/02424

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

**1. Statement**

Novelty (N)	Yes:	Claims	1-6
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-6
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-6
	No:	Claims	

**2. Citations and explanations**

**see separate sheet**

**VII. Certain defects in the international application**

The following defects in the form or contents of the international application have been noted:

**see separate sheet**

**VIII. Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

**see separate sheet**

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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International application No. PCT/EP99/02424

**Re Item I**

**Basis of the report**

1. According to Claims 9-11 an indoor unit comprises an in-house distribution component.

This not disclosed in the application as filed according to which the indoor unit and the in-house distribution components are built as separate pieces of equipment (see description, paragraph spanning pages 15 and 16, figure 11).

2. According to Claims 12-15, when dependant on Claim 1-6, the user site reception system comprises a base station.

The application as filed does not offer any basis for the user site comprising a base station. Further, this does not make sense from a technical point of view.

**Re Item III**

**Non-establishment of opinion with regard to novelty, inventive step and industrial applicability**

1. Claims 12-14 seek protection for a system according to Claims 7-11. However, Claims 7-11 do not define any system but an indoor unit
2. Claims 15-17 seek protection for a base station according to Claim 14. Claim 14, however, does not define a base station but a system comprising the base station.

**Re Item IV**

**Lack of unity of invention**

1. Claim 1 is directed to reducing precision requirements of the local oscillator in user sites. This is done by a base station transmitting a high-precision beacon signal, which is downconverted in the user site, modulated with an upstream signal and upconverted. Downconversion and up conversion are performed using the same local oscillator frequency signal.

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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International application No. PCT/EP99/02424

On the other hand Claim 7 is directed to an indoor unit which controls an outdoor unit or a distribution component. This is done by control means generating switching commands.

2. Hence, the above-mentioned two independent claims have different features and are based on different underlying concepts.
3. It should be mentioned that the common matter of these claims relating to receiving downstream signals from a base station and means for generating upstream signals using a high-precision signal is well known in the art (see point 1 of section V).

**Re Item V**

**Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. The subject-matter of Claim 1 is new and involves an inventive step, Article 33(2)(3).
  - 1.1 Claim 1 is directed to a user-site reception system for receiving TV signals having means for receiving downstream signals from a base station and means for generating upstream signals using a high-precision beacon signal.

Such a system is known from **D1 = WO A 97 48191** or **D2 = WO A 97 21276**.

- 1.2 The subject-matter of Claim 1 addresses the problem of reducing precision requirements of the local oscillator in the user site. This is done by downconverting the beacon signal using a local oscillator frequency signal. Upstream signals are then modulated on the downconverter beacon signal and the modulated beacon signal is upconverted using the same local oscillator frequency signal. In this manner the local oscillator frequency is cancelled and the modulated signal does not depend on local oscillator jitter.
  - 1.3 Using the same local oscillator signal is not suggested by the prior art.

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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International application No. PCT/EP99/02424

In contrary **D1** proposes to use the high-precision beacon frequency to lock the reception oscillator. This leads away from a free running oscillator according to the application.

**D2** has a similar disclosure. This document suggests tracking the beacon by phase-locked loop.

Tracking the beacon signal by a phase-locked loop is also suggested by the intermediate document **EP-A-0 851 618**.

2. Dependent Claims 2-6 relate to specific embodiments of the subject-matter of Claim 1 and are therefore also new and inventive.

**Re Item VII**

**Certain defects in the international application**

1. Claim 1 is not in the two-part form vis-à-vis **D1**, Rule 6.3(b).
2. The claims do not contain reference signs in parentheses, Rule 6.2(b).
3. **D1-D2** are not mentioned in the description and the description is not adapted to the wording of Claim 1, Rule 5.1(a)(ii)(iii).
4. The claims contain handwritten amendments, Rule 11.9(a).

**Re Item VIII**

**Certain observations on the international application**

1. The wording on the first two lines of Claim 4 results in lack of clarity because upstream signal generating means are not defined in Claims 1-3.

This also applies to the first two lines of Claim 5.

2. Claim 13 comprises an expression in parentheses.

Claims

1. A base station for broadcasting or re-broadcasting of TV and/or audio and/or data signals, said station comprising:

means for transmitting downstream signals from said base station to at least one user terminal;

means for receiving upstream signals transmitted from said at least one user terminal;

means for transmitting a high-precision beacon signal as reference signal for the generation of said upstream signals.

2. A base station according to claim 1, wherein said base station forms a part of an LMDS provider-site distribution system, and wherein said base station of said system further comprises one or a combination of the following:

means for baseband processing, modulation, and power combination of downstream carriers and/or

means for block conversion and power amplification of downstream carriers as well as demodulation of arbitrary numbers of upstream carriers;

means for station management;

means for controlling interactively communication frequencies and power;

means for communication with adjacent cells and a remote service provider;

means for communication with other networks like satellite and/or cable.

3. A base station according to one of the preceding claims, said base station comprising:

an upstream reception system with a stack of single demodulators comprising:

means for low noise amplification;

means for downconverting from RF to a first IF level;

means for power splitting;

a downconversion mixer bank for individual upstream carrier downconversion;

means for generating individual LO frequencies;

means for filtering;

a demodulator bank;

means for baseband processing to exploit the incoming demodulated upstream data.

4. A base station according to claim 3, further comprising means for arbitrarily configuring the demodulation mode.

5. A base station according to one of claims 1 or 2, further comprising:  
an upstream reception system with a multicarrier demodulator system comprising:

means for low noise amplification;

means for downconversion from RF to a first IF level;

means for quadrature downconversion;

means for sampling and for A/D-conversion for subsequent signal processing;

means for analytical multicarrier demodulation signal processing;

means for baseband processing.

6. A base station according to one of claims 1 or 2, said base station comprising:

an upstream reception system with a FFT demodulation system comprising:

means for low noise amplification;

means for downconversion from RF to a first IF level;

means for quadrature downconversion;

means for sampling and for A/D-conversion for subsequent signal processing;

means for analytical FFT signal processing;

means for baseband processing.

7. A user-site reception system for receiving TV and/or audio and/or data signals transmitted from a base station, said system comprising:

means for receiving downstream signals transmitted from a base station;

means for generating upstream signals to be transmitted to said base station using a high-precision signal which can be transmitted from said base station as a reference.

8. A user site reception system according to claim 7, wherein said system is a reception-interaction system for a LMDS system, said reception system further comprising:

means for command reception from a base station;

means for user interaction with said base station.

9. A system according to one of claims 7 or 8, said system comprising:

means for exploiting the high-precision beacon signal, said mixer comprising:

frequency processing means for upconverting the upstreams, given by modulator IF outputs, without any influence of parasitic phase noise and drift generated by receiver located conversion LOs;

means for downconversion of downstreams;

means for suitable filtering of frequency bands.

10. A reception system according to one of claims 7 to 9, wherein said means for exploitation of a high-precision beacon signal comprises:

means for downconverting said beacon signal using a first local oscillator frequency;

means for upstream modulation of said upstream signal onto said downconverted signal;

means for upconverting said upstream modulated downconverted signal using said first local oscillator frequency.

11. A reception system according to one of claims 7 to 10, comprising:

at least one upstream signals generating means according to one of claims 7 to 10;

means for processing of polarizations and frequency bands for up- and downstreams;

means for connecting to an IF frequency level to be connected to an in-house distribution infrastructure;

means for connecting to an RF frequency level to be connected to a radiator/receptor;

means for power amplification.

12. A single user outdoor unit, comprising:  
at least one upstream signal generating means according to one of claims 7 to 11;

switching means for switching between frequency bands and polarizations for downstreams and between polarizations for upstreams;

means for connecting to a IF frequency level to be connected to an indoor unit.

13. A unit according to claim 12, further comprising means for remote control (e.g. DiSEqC™) for functions including at least power control and emergency shutoff.

14. An in-house distribution component, comprising:

switching means for switching the connection between individual user indoor units and the outdoor unit.

15. An in-house distribution component according to claim 14, wherein said switching means comprises means for bidirectional switching between the user indoor units and the outdoor unit.

16. An in-house distribution component according to claims 14 or 15, wherein said unit further comprises:

means for controlling the switching in response to signals received from an indoor unit;



means for connecting to an IF frequency level to be connected to an indoor unit.

17. An indoor unit to be connected to an outdoor unit according to claim 12 or 13 or to an in-house distribution component according to one of claims 14 to 16, said indoor unit comprising:

- receiving means for the reception of downstream signals;
- demodulation means for demodulating the downstream signals;
- modulation means for generating an upstream carrier;
- control means for generating switching commands.

18. An indoor unit according to claim 17, further comprising one of the following:

- means for exploiting base station commands to allocate upstream carriers and/or power;
- means to control or shut off the upstream carrier power.

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Europäisches  
Patentamt

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Recherchen-  
abteilung

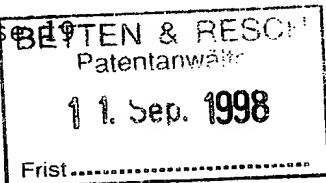
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Datum/Date

08.09.98

Zeichen/Ref./Réf.

BET 018 EP

Anmeldung Nr./Application No./Demande n°/Patent Nr./Patent No./Brevet n°

98106597.2-2209-

Anmelder/Applicant/Demandeur/Patentinhaber/Proprietor/Titulaire

BetaResearch Gesellschaft für Entwicklung und Vermarktung digitaler Infrastruktur

## COMMUNICATION

The European Patent Office herewith transmits as an enclosure the European search report for the above-mentioned European patent application.

If applicable, copies of the documents cited in the European search report are attached.

☒ Additional set(s) of copies of the documents cited in the European search report is (are) enclosed as well.

The following specifications given by the applicant have been approved by the Search Division:

☒ abstract

☐ title

☐ The abstract was modified by the Search Division and the definitive text is attached to this communication.

The following figure will be published together with the abstract:

1

## REFUND OF THE SEARCH FEE

If applicable under Article 10 Rules relating to fees, a separate communication from the Receiving Section on the refund of the search fee will be sent later.





DOCUMENTS CONSIDERED TO BE RELEVANT															
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)												
E	EP 0 851 618 A (TEXAS INSTRUMENTS INC) 1 July 1998 * abstract * * column 5, line 42 - line 55 * * column 6, line 11 - line 14 * * column 7, line 34 - column 47 * * claims 7,9 * * figures 3-6 * ---	1,7,9, 10,12	H04H1/00 H04H9/00 H04N7/173												
X	EP 0 713 347 A (AT & T CORP) 22 May 1996 * abstract * * column 3, line 49 - column 4, line 7 * * column 14, line 11 - column 52 * * claim 1 * ---	1,7													
A	* figures 1-4 *	2,3													
X	WO 97 48196 A (BELLSOUTH CORP) 18 December 1997 * abstract * * page 8, line 24 - line 27 * * page 11, line 9 - line 16 * * page 12, line 2 - line 9 * * claims 1,6 * ---	12,14													
A	* figures 1,3-5 *	1,7,11													
A	WO 97 48191 A (BUGAS DMITRY ;GRAVES H DAVID (CA); BROADBAND NETWORKS INC (CA); SC) 18 December 1997 * abstract * * page 20, line 20 - line 35 * * claim 33 * * figures 1-3,6 * --- -/--	1-3,7, 11,12													
The present search report has been drawn up for all claims															
Place of search THE HAGUE		Date of completion of the search 2 September 1998	Examiner Simon, V												
<table border="0"><tr><td>CATEGORY OF CITED DOCUMENTS</td><td>T : theory or principle underlying the invention</td></tr><tr><td>X : particularly relevant if taken alone</td><td>E : earlier patent document, but published on, or after the filing date</td></tr><tr><td>Y : particularly relevant if combined with another document of the same category</td><td>D : document cited in the application</td></tr><tr><td>A : technological background</td><td>L : document cited for other reasons</td></tr><tr><td>O : non-written disclosure</td><td>&amp; : member of the same patent family, corresponding document</td></tr><tr><td>P : intermediate document</td><td></td></tr></table>				CATEGORY OF CITED DOCUMENTS	T : theory or principle underlying the invention	X : particularly relevant if taken alone	E : earlier patent document, but published on, or after the filing date	Y : particularly relevant if combined with another document of the same category	D : document cited in the application	A : technological background	L : document cited for other reasons	O : non-written disclosure	& : member of the same patent family, corresponding document	P : intermediate document	
CATEGORY OF CITED DOCUMENTS	T : theory or principle underlying the invention														
X : particularly relevant if taken alone	E : earlier patent document, but published on, or after the filing date														
Y : particularly relevant if combined with another document of the same category	D : document cited in the application														
A : technological background	L : document cited for other reasons														
O : non-written disclosure	& : member of the same patent family, corresponding document														
P : intermediate document															

1  
EPO FORM 1503 03.82 (P04C01)



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	WO 97 21276 A (STANFORD TELECOMM INC) 12 June 1997 * abstract * * claim 1 * * page 9, line 3 - page 10, line 8 * * page 37, line 19 - page 40, line 28 * * figures 1,17-21 *	1,5,7	
A	EP 0 825 775 A (PHILIPS ELECTRONICS NV) 25 February 1998 * abstract * * column 3, line 32 - line 48 *	12,13	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 2 September 1998	Examiner Simon, V
<div>CATEGORY OF CITED DOCUMENTS</div> <div><div>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</div><div>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons &amp; : member of the same patent family, corresponding document</div></div>			

1  
EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 98 10 6597

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on. The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

02-09-1998

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
EP 0851618	A	01-07-1998	JP	10200473 A	31-07-1998
EP 0713347	A	22-05-1996	US	5570355 A	29-10-1996
			CA	2162611 A	18-05-1996
			CN	1151094 A	04-06-1997
			JP	8251237 A	27-09-1996
WO 9748196	A	18-12-1997	AU	3482497 A	07-01-1998
WO 9748191	A	18-12-1997	AU	3021997 A	07-01-1998
WO 9721276	A	12-06-1997	AU	1078197 A	27-06-1997
EP 0825775	A	25-02-1998	FR	2752502 A	20-02-1998
			JP	10093888 A	10-04-1998

## PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>BET 018 WO</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/EP 99/02424</b>	International filing date (day/month/year) <b>09/04/1999</b>	(Earliest) Priority Date (day/month/year) <b>09/04/1998</b>
Applicant <b>BETARESEARCH et al.</b>		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

## 1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☐ the text is approved as submitted by the applicant.

☒ the text has been established by this Authority to read as follows:

**BIDIRECTIONAL BROADCASTING SYSTEM**

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

1  
☐ None of the figures.

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 99/02424

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 H04H1/00 H04H9/00 H04N7/173

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 H04H H04Q H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P, X	EP 0 851 618 A (TEXAS INSTRUMENTS INC) 1 July 1998 (1998-07-01) abstract column 5, line 42 - line 55 column 6, line 11 - line 14 column 7, line 34 - column 47 claims 7,9 figures 3-6	1,7,9, 10,12
X	EP 0 713 347 A (AT & T CORP) 22 May 1996 (1996-05-22) abstract column 3, line 49 - column 4, line 7 column 14, line 11 - column 52 claim 1	1,7
A	figures 1-4 --- -/--	2,3

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

## \* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&amp;" document member of the same patent family

Date of the actual completion of the international search

24 August 1999

Date of mailing of the international search report

01/09/1999

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Simon, V

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 99/02424

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 97 48196 A (BELLSOUTH CORP) 18 December 1997 (1997-12-18) abstract page 8, line 24 - line 27 page 11, line 9 - line 16 page 12, line 2 - line 9 claims 1,6	12,14
A	figures 1,3-5 ---	1,7,11
A	WO 97 48191 A (BUGAS DMITRY ;GRAVES H DAVID (CA); BROADBAND NETWORKS INC (CA); SC) 18 December 1997 (1997-12-18) abstract page 20, line 20 - line 35 claim 33 figures 1-3,6 ---	1-3,7, 11,12
A	WO 97 21276 A (STANFORD TELECOMM INC) 12 June 1997 (1997-06-12) abstract claim 1 page 9, line 3 - page 10, line 8 page 37, line 19 - page 40, line 28 figures 1,17-21 ---	1,5,7
A	EP 0 825 775 A (PHILIPS ELECTRONICS NV) 25 February 1998 (1998-02-25) abstract column 3, line 32 - line 48 -----	12,13



## INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/EP 99/02424

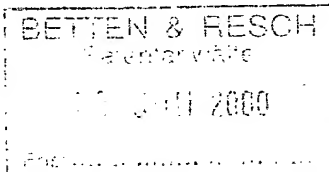
Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0851618	A	01-07-1998	JP 10200473 A	31-07-1998
EP 0713347	A	22-05-1996	US 5570355 A	29-10-1996
			CA 2162611 A	18-05-1996
			CN 1151094 A	04-06-1997
			JP 8251237 A	27-09-1996
WO 9748196	A	18-12-1997	US 5867485 A	02-02-1999
			AU 3482497 A	07-01-1998
			CA 2257978 A	18-12-1997
			EP 0906672 A	07-04-1999
WO 9748191	A	18-12-1997	AU 3021997 A	07-01-1998
			CA 2257967 A	18-12-1997
			EP 0904639 A	31-03-1999
WO 9721276	A	12-06-1997	US 5809431 A	15-09-1998
			AU 1078197 A	27-06-1997
			BR 9611926 A	30-03-1999
			CA 2237463 A	12-06-1997
			CN 1214815 A	21-04-1999
			EP 0873594 A	28-10-1998
EP 0825775	A	25-02-1998	FR 2752502 A	20-02-1998
			JP 10093888 A	10-04-1998

# PATENT COOPERATION TREATY

From the  
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

BETTEN & RESCH  
Reichenbachstrasse 19  
D-80469 München  
ALLEMAGNE



## PCT

### NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT (PCT Rule 71.1)

Date of mailing  
(day/month/year) 13.07.2000

Applicant's or agent's file reference  
BET 018 WO

#### IMPORTANT NOTIFICATION

International application No.  
PCT/EP99/02424

International filing date (day/month/year)  
09/04/1999

Priority date (day/month/year)  
09/04/1998

Applicant  
BETARESEARCH et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

#### 4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/



European Patent Office  
D-80298 Munich  
Tel. +49 89 2399 - 0 Tx: 523656 epmu d  
Fax: +49 89 2399 - 4465

Authorized officer

Pelatti, V

Tel. +49 89 2399-7309



# PATENT COOPERATION TREATY

## PCT

### INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference <b>BET 018 WO</b>	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. <b>PCT/EP99/02424</b>	International filing date ( <i>day/month/year</i> ) <b>09/04/1999</b>	Priority date ( <i>day/month/year</i> ) <b>09/04/1998</b>
International Patent Classification (IPC) or national classification and IPC <b>H04H1/00</b>		
Applicant <b>BETARESEARCH et al.</b>		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
  
2. This REPORT consists of a total of 7 sheets, including this cover sheet.
 

☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 5 sheets.

3. This report contains indications relating to the following items:

- I    ☒ Basis of the report
- II   ☐ Priority
- III ☒ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV  ☒ Lack of unity of invention
- V    ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI   ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand  <b>09/11/1999</b>	Date of completion of this report  <b>13.07.2000</b>
Name and mailing address of the international preliminary examining authority: <div style="display: flex; align-items: center;"> <div>                     European Patent Office                      D-80298 Munich                      Tel. +49 89 2399 - 0 Tx: 523656 epmu d                      Fax: +49 89 2399 - 4465                 </div> </div>	Authorized officer  <b>Pajatakis, E</b>  Telephone No. +49 89 2399 8898



**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/EP99/02424

**I. Basis of the report**

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

**Description, pages:**

1-16 as originally filed

**Claims, No.:**

1-17 as received on 08/06/2000 with letter of 08/06/2000

**Drawings, sheets:**

1/13-13/13 as originally filed

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:  
☐ the claims, Nos.:  
☐ the drawings, sheets:

3. ☒ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

**see separate sheet**

4. Additional observations, if necessary:

**III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability**

The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

- ☐ the entire international application.  
☒ claims Nos. 12-17.

because:

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/EP99/02424

☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (*specify*):

☒ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. 12-17 are so unclear that no meaningful opinion could be formed (*specify*):

**see separate sheet**

☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

☐ no international search report has been established for the said claims Nos. .

**IV. Lack of unity of invention**

1. In response to the invitation to restrict or pay additional fees the applicant has:

☒ restricted the claims.

☐ paid additional fees.

☐ paid additional fees under protest.

☐ neither restricted nor paid additional fees.

2. ☐ This Authority found that the requirement of unity of invention is not complied and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

☐ complied with.

☒ not complied with for the following reasons:

**see separate sheet**

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

☐ all parts.

☒ the parts relating to claims Nos. 1-6,12-17.

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/EP99/02424

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**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

**1. Statement**

Novelty (N)	Yes:	Claims	1-6
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-6
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-6
	No:	Claims	

**2. Citations and explanations**

**see separate sheet**

**VII. Certain defects in the international application**

The following defects in the form or contents of the international application have been noted:

**see separate sheet**

**VIII. Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

**see separate sheet**

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

---

International application No. PCT/EP99/02424

**Re Item I**

**Basis of the report**

1. According to Claims 9-11 an indoor unit comprises an in-house distribution component.

This not disclosed in the application as filed according to which the indoor unit and the in-house distribution components are built as separate pieces of equipment (see description, paragraph spanning pages 15 and 16, figure 11).

2. According to Claims 12-15, when dependant on Claim 1-6, the user site reception system comprises a base station.

The application as filed does not offer any basis for the user site comprising a base station. Further, this does not make sense from a technical point of view.

**Re Item III**

**Non-establishment of opinion with regard to novelty, inventive step and industrial applicability**

1. Claims 12-14 seek protection for a system according to Claims 7-11. However, Claims 7-11 do not define any system but an indoor unit
2. Claims 15-17 seek protection for a base station according to Claim 14. Claim 14, however, does not define a base station but a system comprising the base station.

**Re Item IV**

**Lack of unity of invention**

1. Claim 1 is directed to reducing precision requirements of the local oscillator in user sites. This is done by a base station transmitting a high-precision beacon signal, which is downconverted in the user site, modulated with an upstream signal and upconverted. Downconversion and up conversion are performed using the same local oscillator frequency signal.

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

---

International application No. PCT/EP99/02424

On the other hand Claim 7 is directed to an indoor unit which controls an outdoor unit or a distribution component. This is done by control means generating switching commands.

2. Hence, the above-mentioned two independent claims have different features and are based on different underlying concepts.
3. It should be mentioned that the common matter of these claims relating to receiving downstream signals from a base station and means for generating upstream signals using a high-precision signal is well known in the art (see point 1 of section V).

**Re Item V**

**Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. The subject-matter of Claim 1 is new and involves an inventive step, Article 33(2)(3).
  - 1.1 Claim 1 is directed to a user-site reception system for receiving TV signals having means for receiving downstream signals from a base station and means for generating upstream signals using a high-precision beacon signal.

Such a system is known from **D1 = WO A 97 48191** or **D2 = WO A 97 21276**.

- 1.2 The subject-matter of Claim 1 addresses the problem of reducing precision requirements of the local oscillator in the user site. This is done by downconverting the beacon signal using a local oscillator frequency signal. Upstream signals are then modulated on the downconverter beacon signal and the modulated beacon signal is upconverted using the same local oscillator frequency signal. In this manner the local oscillator frequency is cancelled and the modulated signal does not depend on local oscillator jitter.
  - 1.3 Using the same local oscillator signal is not suggested by the prior art.



**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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International application No. PCT/EP99/02424

In contrary **D1** proposes to use the high-precision beacon frequency to lock the reception oscillator. This leads away from a free running oscillator according to the application.

**D2** has a similar disclosure. This document suggests tracking the beacon by phase-locked loop.

Tracking the beacon signal by a phase-locked loop is also suggested by the intermediate document **EP-A-0 851 618**.

2. Dependent Claims 2-6 relate to specific embodiments of the subject-matter of Claim 1 and are therefore also new and inventive.

**Re Item VII**

**Certain defects in the international application**

1. Claim 1 is not in the two-part form vis-à-vis **D1**, Rule 6.3(b).
2. The claims do not contain reference signs in parentheses, Rule 6.2(b).
3. **D1-D2** are not mentioned in the description and the description is not adapted to the wording of Claim 1, Rule 5.1(a)(ii)(iii).
4. The claims contain handwritten amendments, Rule 11.9(a).

**Re Item VIII**

**Certain observations on the international application**

1. The wording on the first two lines of Claim 4 results in lack of clarity because upstream signal generating means are not defined in Claims 1-3.

This also applies to the first two lines of Claim 5.

2. Claim 13 comprises an expression in parentheses.

20  
 11 08 08 00

Claims

422 Rec'd PCT/PTO 06 OCT 2000

1. ~~7.~~ A user-site reception system for receiving TV and/or audio and/or data signals transmitted from a base station, said system comprising:

means for receiving downstream signals transmitted from a base station;

means for generating upstream signals to be transmitted to said base station using a high-precision signal which can be transmitted from said base station as a reference, *said means for generating upstream signals further comprising:*  $\int \leftarrow \rightarrow \int$

2. ~~8.~~ A user site reception system according to claim <sup>1</sup>~~7~~, wherein said system is a reception-interaction system for a LMDS system, said reception system further comprising:

means for command reception from a base station;

means for user interaction with said base station.

3. ~~9.~~ A system according to one of claims <sup>1</sup>~~7~~ or <sup>2</sup>~~8~~, said system comprising:  
 means for exploiting the high-precision beacon signal, said mixer comprising:

frequency processing means for upconverting the upstreams, given by modulator IF outputs, without any influence of parasitic phase noise and drift generated by receiver located conversion LOs;

means for downconversion of downstreams;

means for suitable filtering of frequency bands.

~~10. A reception system according to one of claims 7 to 9, wherein said means for exploitation of a high-precision beacon signal comprises:~~

< means for downconverting said beacon signal using a ~~first~~ local oscillator frequency;

means for upstream modulation of said upstream signal onto said downconverted signal;

means for upconverting said upstream modulated downconverted signal using said ~~first~~ local oscillator frequency, *which has been used for downconverting.* >

14-22-08.00

8. ~~15~~. An indoor unit according to claim ~~14~~<sup>7</sup>, further comprising one of the following:

means for exploiting base station commands to allocate upstream carriers and/or power;

means to control or shut off the upstream carrier power.

9. ~~16~~. An indoor unit according to one of claims ~~14~~<sup>7</sup> or ~~15~~<sup>8</sup>, further comprising:  
an in-house distribution component, comprising:

switching means for switching the connection between individual user indoor units and the outdoor unit.

10. ~~17~~. An indoor unit according to claim ~~16~~<sup>9</sup>, wherein

said switching means comprises means for bidirectional switching between the user indoor units and the outdoor unit.

11. ~~18~~. An indoor unit according to one of claims ~~16~~<sup>9</sup> or ~~17~~<sup>10</sup>, wherein

said in-house distribution component further comprises:

means for controlling the switching in response to signals received from said indoor unit;

means for connecting to an IF frequency level to be connected to said indoor unit.

12. A system according to one of claims 1 to 11, further comprising:

→ page 22a

- 2 2 a -  
18  
11 08.08.00

-Claims-

<sup>a</sup>  
1. ~~A~~ base station for broadcasting or re-broadcasting of TV and/or audio and/or data signals, said station comprising:

means for transmitting downstream signals from said base station to at least one user terminal;

means for receiving upstream signals transmitted from said at least one user terminal;

means for transmitting a high-precision beacon signal as reference signal for the generation of said upstream signals.

13. <sup>system</sup> ~~2. A base station~~ according to claim <sup>72</sup> 1, wherein said base station forms a part of an LMDS provider-site distribution system, and wherein said base station of said system further comprises one or a combination of the following:

means for baseband processing, modulation, and power combination of downstream carriers and/or

means for block conversion and power amplification of downstream carriers as well as demodulation of arbitrary numbers of upstream carriers;

means for station management;

means for controlling interactively communication frequencies and power;

means for communication with adjacent cells and a remote service provider; means for communication with other networks like satellite and/or cable.

14. <sup>system</sup> ~~3. A base station~~ according to one of the preceding claims, said base station comprising:

an upstream reception system with a stack of single demodulators comprising:

means for low noise amplification;

means for downconverting from RF to a first IF level;

means for power splitting;

→ page 22 b

- 22 b -  
- 18 -  
11 05 05 00

a downconversion mixer bank for individual upstream carrier downconversion;

means for generating individual LO frequencies;

means for filtering;

a demodulator bank;

means for baseband processing to exploit the incoming demodulated upstream data.

15. ~~4.~~ A base station according to claim <sup>14</sup>~~3~~, further comprising means for arbitrarily configuring the demodulation mode.

16. ~~5.~~ A base station according to one of claims <sup>12</sup>~~1~~ or <sup>13</sup>~~2~~, further comprising:  
an upstream reception system with a multicarrier demodulator system comprising:

means for low noise amplification;

means for downconversion from RF to a first IF level;

means for quadrature downconversion;

means for sampling and for A/D-conversion for subsequent signal processing;

means for analytical multicarrier demodulation signal processing;

means for baseband processing.

17. ~~6.~~ A base station according to one of claims <sup>12</sup>~~1~~ or <sup>13</sup>~~2~~, said base station comprising:

an upstream reception system with a FFT demodulation system comprising:

means for low noise amplification;

means for downconversion from RF to a first IF level;

means for quadrature downconversion;

means for sampling and for A/D-conversion for subsequent signal processing;

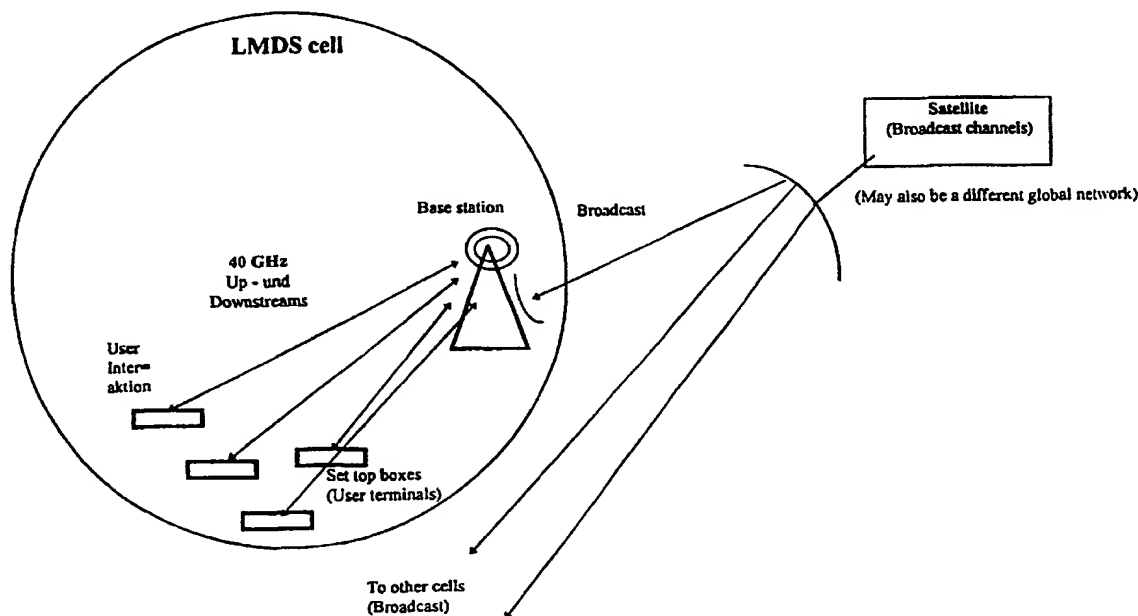
means for analytical FFT signal processing;

means for baseband processing.



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<b>(21) International Application Number:</b> PCT/EP99/02424 <b>(22) International Filing Date:</b> 9 April 1999 (09.04.99) <b>(30) Priority Data:</b> 98106597.2      9 April 1998 (09.04.98)      EP <b>(71) Applicant (for all designated States except US):</b> BETARESEARCH GESELLSCHAFT FÜR ENTWICKLUNG UND VERMARKTUNG DIGITALER INFRASTRUKTUREN MBH [DE/DE]; Betastrasse 1, D-85774 Unterföhring (DE). <b>(72) Inventors; and</b> <b>(75) Inventors/Applicants (for US only):</b> HEICHLER, Johannes [DE/DE]; BetaResearch Gesellschaft für Entwicklung und Vermarktung digitaler Infrastrukturen mbH, Betastrasse 1, D-85774 Unterföhring (DE). GILLIES, David [DE/DE]; BetaResearch Gesellschaft für Entwicklung und Vermarktung digitaler Infrastrukturen mbH, Betastrasse 1, D-85774 Unterföhring (DE). HENSELMANN-WEISS, Wolfgang [DE/DE]; BetaResearch Gesellschaft für Entwicklung und Vermarktung digitaler Infrastrukturen mbH, Betastrasse 1, D-85774 Unterföhring (DE). KEMPF, Andreas [DE/DE]; BetaResearch Gesellschaft für Entwicklung und Vermarktung digitaler Infrastrukturen mbH, Betastrasse 1, D-85774 Unterföhring (DE). TOTTH, Gabor [DE/DE]; BetaResearch		Gesellschaft für Entwicklung und Vermarktung digitaler Infrastrukturen mbH, Betastrasse 1, D-85774 Unterföhring (DE). <b>(74) Agent:</b> BETTEN & RESCH; Reichenbachstrasse 19, D-80469 München (DE). <b>(81) Designated States:</b> AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). <b>Published</b> <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>

**(54) Title:** BIDIRECTIONAL BROADCASTING SYSTEM**(57) Abstract**

A base station for broadcasting or re-broadcasting of TV and/or audio and/or data signals, said station comprising: means for transmitting downstream signals from said base station to at least one user terminal; means for receiving upstream signals transmitted from said at least one user terminal; means for transmitting a high-precision beacon signal as reference signal for the generation of said upstream signals.

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## BIDIRECTIONAL BROADCASTING SYSTEM

FIELD OF THE INVENTION

The present invention relates to a system suitable for RF distribution of analogue and digital television signals as well as forward (here called: downstream) interaction channels.

Technical means for generating a return channel from the user's premises are provided to perform the (here called: upstream) interaction from the user.

Additional means to guarantee a certain quality of the user radiated signal are provided in the system.

Systems like these are often called "LMDS" (Local Multipoint Distribution System) and can be used for re-broadcasting programmes from satellite or cable as well as providing a service for interaction within or besides the broadcasting scenario. The channel bandwidth is flexible for each direction.

BACKGROUND OF THE INVENTION

LMDS comprises systems for distribution of video and audio signals by microwave links in small-area coverage regions. Thus, LMDS often is called "wireless cable" incorporating the distribution of signals from a base station within a cell composed of a defined number of users with set top boxes as terminals. E.g. the carrier frequency range from 40.5 ... 42.5 GHz is a possible operation range for this service.

As a state-of-the-art, analogue (FM modulated) systems for video and audio distribution are beginning to become available on the market. With certain modifications an application for digital carriers (quarternary phase shift keying QPSK modulation) is possible. Return channels for interactions so far are not yet implemented.



The RF distribution is generally performed by using horn antennas with a gain of approximately 15 dBi at the base station site and 35 dBi at the user terminal site. The coverage of the system often is indicated with a radius ranging from 1 ... 5 Km depending on weather conditions (rain attenuation). A basic problem is revealed by the fact that the user terminal has to radiate a return channel signal with sufficient stability and broadcasting quality in the 40 GHz range which is not yet technically solved in terms of a reliable and mass-market suitable solution.

### SUMMARY OF THE INVENTION

It is therefore an object of the invention to provide the systematical and technical solution of an LMDS system for the operation in the 40 GHz frequency resource or above.

It is also an object of the invention to provide technical means for an improvement of the signal radiated by the user terminal (set top box).

A further object of the invention is the facility to separate the 40 GHz signal processing from the modulation processing in a way that

1. A separate outdoor unit may be defined remote from the modulation equipment.

2. The cabling running from the said modulation equipment to the said outdoor unit can be structured like conventional SMATV (Satellite Mastered Antenna TV) equipment for inhouse distribution.

The invention is defined in the independent claims. The dependent claims define particular embodiments of the invention.

According to one embodiment of the invention there is provided a base station consisting of a transmitter system composed of a radiation and reception antenna as a combined or separate devices, a power amplification stage, an upconversion stage as well as a multicarrier modulation equipment for yielding one

or more carriers for broadcasting or interaction activity with variable symbol rates and signal bandwidths. The base station also consists of reception paths comprising low noise receivers connected to the antenna, down converters to present the received spectrum within a defined IF range as well as analyser - demodulator stages to exploit the carriers received. Additional links of the base station to other telecommunication networks as e.g. satellite segments are provided. In this case suitable interfaces to the said networks are to be defined, which can be done in a well-known manner.

According to an aspect of the invention there is provided a highly stable frequency reference ("beacon") to be radiated together with the other carriers at a well-defined location in the spectrum with the purpose to offer a return channel transmission reference frequency for the user terminals.

According to an embodiment of the invention there is provided a user terminal at the user's site to receive the said signals radiated by the base station and to process them in a suitable manner for enabling broadcasting reception and mutual interaction between the base station and the user.

According to a further embodiment of the invention data signalling between the base station and the user terminals as well as vice-versa is provided. Details of signalling as e.g. the data format, the protocols etc. may be a subject to change depending on special solution.

In an embodiment of the invention to be described in detail hereinafter the LMDS system structure comprises a base station with a partitioning of the frequency resource as well as a user terminal.

In another embodiment of the invention to be described in detail hereinafter the technical means for receiving the beacon as well as the downstream carriers comprises a low noise amplifier in combination with a block down converter. Suitable filters to reject image frequencies are also applied.

In a further embodiment of the invention to be described in detail hereinafter the technical means for exploiting the highly stable reference frequency comprises oscillators, synthesizers and mixers as well as suitable filters.

In a further embodiment of the invention to be described in detail hereinafter the technical means for radiating the upstream carrier from the user terminal comprises a suitable modulator, a sufficient stable local oscillator and a suitable upconverter. Suitable filters to reject image frequencies are also applied.

In a further embodiment of the invention to be described in detail hereafter the technical means for exploiting the user radiated upstream carriers at the base station's site comprises FFT (Fast Fourier Transform) circuits or MCD (Multi Carrier Demodulator) as well as a stack of single carrier demodulator circuits.

In a further embodiment of the invention to be described in detail hereafter the technical means and structures for enabling single user as well as SMATV featured operation at the user terminal's site comprises DiSEqC<sup>TM</sup> (Digital Satellite Equipment Control) or analogue switching criteria compatible switches as well as conventional in-house cabling equipment.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The invention will hereinafter be described with reference to the accompanying drawings, in which:

FIG. 1 shows the structure of one so-called LMDS cell;

FIG. 2 depicts the repeated array of a plenty of said cells;

FIG. 3 expresses an example of the spectrum yielded by the base station as well as the user terminal;

FIG. 4a shows the downstream generation by block conversion of completely backhauled carrier combs;

FIG. 4b describes the downstream generation by power combination of single modulator signals;

FIG. 5 describes a compact solution for the processing of the downstream carriers, the beacon and the upstream carrier(s) ;

FIG. 6 describes the application of FIG. 5 as a component to be used for construction of a universal outdoor unit for in-house distribution;

FIG. 7 demonstrates the reception of the upstreams with a stack of single demodulators;

FIG. 8 demonstrates the same reception with a multicarrier demodulator;

FIG. 9 demonstrates the same reception using an FFT stage;

FIG. 10 describes the structure of a single user application;

FIG. 11 describes the same structure for multi user operation like SMATV;

FIG. 12 shows schematically the aerial structure composed of the elements of FIG. 6 and a waveguiding/filtering system.

#### DETAILED DESCRIPTION OF THE EMBODIMENTS

According to an embodiment of the invention, an LMDS structure (FIG.1) generally shows up as a point - to - multipoint distribution on one hand concerning the paths running from the base station to the user terminals and as a multipoint - to - point distribution on the other hand concerning the paths running from the user terminals to the base station. No signal way is switched bypassing the base station.

The LMDS structure repeats itself (FIG.2) in the shape of so-called cells comprising an entity of users forming a group in the sense that this group is supplied with all necessary signals by the base station. The base station itself comprises the facility to exchange signals with other networks as e.g. satellite space segments. It may consist of RF processing equipment as well as baseband processing equipment in its farthest sense. FIG.3 shows the possible spectral resource exploited by the communication partners: It comprises for two polarizations, horizontal and vertical, the downstream carriers denoted from e.g. 40.6 ... 42.65 GHz, a beacon located at e.g. 42.75 GHz as well as the upstream carriers denoted from e.g. 42.85 ... 43.4 GHz. Suitable guard bands are inserted at the borders of each particular resource.

The generation of the downstream RF signal is one major task of the base station.

Generally there are two possibilities to radiate downstreams in a wide band multicarrier manner:

a) Re-Broadcasting e.g. a complete satellite segment by block upconversion to 40 GHz, without remodulation. In this case, the content of the downstreams is not changed.

b) Remodulation of a selected subset of channels, e.g. from telecom's cable systems or satellite with adoption of adjacent data information like NIT (Network Information Table) and/or generation of interaction. In this case, a construction of power combination at an IF or RF level may be provided.

FIG. 4a shows the first approach: A satellite segment is received as a whole by a so-called "backhaul antenna" and firstly downconverted to the SAT IF band by a so-called wide band LNB (Low Noise Block Converter). This frequency band is then filtered and power levelled to adopt to the upconversion stage following. After another filter for image band rejection the re-broadcasting signal is power amplified by a HPA (High Power Amplifier) to supply the antenna with sufficient amplitude per channel required by the overall path link budget.

It is important to note that for this kind of multicarrier uplink sufficient power amplifier backoff must be provided to keep inter-carrier-intermodulation below certain values. Thus, the total available linear operation power of an  $N$  - carrier amplifier must be backed off by at least  $BO = 20 \log(N)$ , i.e. for a single carrier, no backoff is necessary, for two carriers, 6 dB backoff must be provided due to the double beat frequency amplitude etc.. This results that for large re-broadcasting scenarios HPAs with sufficient saturation power must be implemented, which can be done by using TWTs (travelling wave tubes) or wide-band high-power semiconductor amplifiers.

FIG. 4b shows the power combination approach for the IF or the RF level, here drawn as an example for the IF level: TV programmes as well as data may be collected from remote ("channels from remote") e.g. by reception and demodulation. In a baseband processing stage, which may be of distributed structure, the transport

data streams are combined in a wanted manner. Here, also interaction channels can be inserted. Then the resulting streams are fed into the downstream modulators providing at each output an e.g. QPSK modulated digital carrier signal. These carriers are upconverted in a first stage by a LO (local oscillator) and filter management, power combined to achieve a carrier comb of all signals as a sum and then further upconverted to RF level. This is the resulting frequency multiplex for the HPA to be radiated to the user terminals.

Of course, a combination of both solutions is possible, e.g. if re-broadcasting channels are mixed with embedded or non-embedded interaction downstreams.

Another solution is the combination of single carriers at the RF level by single amplifiers, filters and power combiners, as it is known from satellite uplinks, or the use of one antenna per channel, but these solutions are not described here in detail because of the lack of economy when a plenty of carriers (30 transponders per satellite segment / one polarization!) shall be radiated.

The communication between the cells as well as the communication with a remote service provider may be realized by using conventional foreign networks (telecom's networks) or alternatively special networks tailored for this purpose.

The so-called user terminal mainly consists of two blocks (see also FIG.10): An outdoor unit and an indoor unit. In case of a house distribution (see also FIG.11) of LMDS IF signals, the user terminal embodies each path being rooted from the building roof (outdoor) via cables, switches etc. through the building to the set top box into the user's room (indoor). The set top box comprises means for reception (selection) of an IF level downstream channel as well as means for transmission (modulation) of an IF level upstream channel. In addition to this, means for transmitting a command set (e.g. DiSEqC™) are provided for governing the outdoor unit / in-house distribution switches.

The purpose when exploiting the highly stable radiated beacon signal is to upconvert the modulation signal of the upstream by keeping the quality of the said beacon clean carrier. In practice, the upconversion incorporates some necessary

filtering to separate the wanted signals from unwanted image signals as well as from wanted signals in the spectral vicinity of the beacon. This filtering is hardly feasible at the 40 GHz level due to the limitation of slope steepness being necessary for separation. Thus, filtering must be performed at a suitable IF level.

Converting the high quality beacon signal to an IF level unfortunately means involving another low - quality local oscillator in the process and therefore a degradation of the result. A way out of this problem concerns a further embodiment of the invention comprising a so-called differential mixing stage as shown in a specific embodiment in FIG. 5.

The same stage serves for downconverting the downstream carriers to a suitable IF level, and the same stage serves for upconverting the upstream carrier(s) to the wanted 40 GHz RF level.

A downconversion of the beacon signal is performed by a first mixing, the resulting signal is filtered, and a modulation then is added. The modulated signal is filtered and then upconverted, thereby the jitter of the local oscillator signal is cancelled out. Simultaneously, a downconversion of the downstream signal  $f_{\text{down}}$  is performed using the first mixer also used for the beacon signal. The thereby downconverted signal is coupled out using a beam splitter. This will become more apparent from the following detailed description in connection with Fig.-5.

FIG. 5 shows the technical block circuit diagram for realization: A suitable antenna consisting of e.g. a dish reflector or a lens microwave collimator is equipped with a multiport feed enabling the separated routing of transmission and reception power. Here, the two ports for one linear polarization are shown.

At the reception port, a low noise amplifier LNA is connected to enhance the reception signal power of the two signals  $f_{\text{beacon}}$  and  $f_{\text{down}}$ . A first mixing stage M1 downconverts these signals to an IF level with the aid of a suitable oscillator DRO and two frequency doublers postconnected. This oscillator signal enters M1 with the frequency  $f_{\text{LO}} + \Delta f$  where  $\Delta f$  denotes phase noise and drift introduced.

As a first result, the IF level of the downstreams is achieved by a power splitter SP presenting the signals at

$$f_{\text{down}} = f_{\text{LO}} - \Delta f$$

for the user terminal IF input. The value  $\Delta f$  has in this case to cope with user terminal input phase noise and drift requirements like conventional satellite downlink LNBS feature.

Note, that the  $\Delta f$  magnitude occurs at this point with negative sign.

Further, a filter F1 extracts the downconverted beacon signal at the spectral level

$$f_{\text{beacon}} = f_{\text{LO}} - \Delta f$$

behind the second port of SP with sufficient bandwidth to keep the entire  $\Delta f$  magnitude for further processing.

In a next step, the modulation frequency  $f_{\text{mod}}$  is added by a second signal multiplier M2 which results a spectral level:

$$f_{\text{beacon}} = f_{\text{LO}} - \Delta f + f_{\text{mod}}$$

and which is filtered again with sufficient bandwidth to keep the entire  $\Delta f$  magnitude.

A last upconversion of this signal is performed by a third mixer M3 yielding:

$$\begin{aligned} f_{\text{beacon}} &= f_{\text{LO}} - \Delta f + f_{\text{mod}} + f_{\text{LO}} + \Delta f \\ &= f_{\text{beacon}} + f_{\text{mod}} \end{aligned}$$

with the basic result that the signal entering the transmitter power output stage PA only comprises the errors of the two components  $f_{\text{beacon}}$  and  $f_{\text{mod}}$ . Since these errors are well - defined and small ( $f_{\text{mod}}$  is a frequency within the range of 100



MHz or somewhat more and thus can be easily generated by crystal oscillator technique), the upstream signal achieves broadcasting quality with only few ppm drift and phase noise avoiding exhaustive costs.

In principle, the beacon signal operating as a reference frequency could also be generated at the user-site, e.g. at the outdoor unit or even at the set-top box as soon as such a solution becomes technically feasible in terms of the quality and the costs of the corresponding oscillators being available.

According to a further embodiment, the incoming upstreams are located at arbitrary places in the provided spectral resource range (see FIG.3). In case of TDMA (Time Division Multiple Access) operation the suitable modulation method will be a burst modulation starting and stopping carrier radiation synchronously to a master clock or asynchronously by a base station command, in case of continuous operation, user carrier switching on and off will only be done at beginning and end of transmission by base station frequency management.

In both cases, suitable demodulation equipment serves for extracting digital data from carrier. This extraction can be generally performed by three means:

1) Separate demodulators, as many as carriers are on air, 2) so-called multicarrier demodulators (MCD) being able to demodulate N carriers by one device, 3) so-called fast fourier transformers (FFT) being capable to analyse the whole spectrum being on-air and to present the result by real and imaginary component data, which is similar to demodulation. The embodiments shown in Figures 7 to 9 respectively illustrate these three possibilities for demodulation.

FIG. 7 shows solution 1) with the separate demodulators: The incoming RF signal as a whole is in a first step received by a sufficient wide-angle antenna, then low - noise amplified and downconverted with a first LO to an IF level for better further processing. This LO might be switched in frequency for suitable range selection, if necessary. Then, the signal is pre-filtered and amplified a second time to be splitted by a power splitter and to be downconverted by an N-fold downconverter bank followed by an N-fold filter bank for the second IF level. The number N

corresponds to the number of subscribers associated to one base station and therefore to one LMDS cell. The downconverter oscillator frequencies for the downconverter bank are organized by a so - called 2<sup>nd</sup> LO management stage comprising a synthesizer stage with a computer interface. This interface accepts data from the station computer serving for the station management as a whole. The station computer is also a means for communication with other base stations or the central service provider as well as for processing the internal station data streams.

The filter bank is followed by an N-fold demodulator bank being capable to present the upstream carrier content in the baseband format for further baseband processing. This processing depends on the momentaneous LMDS return channel application and therefore is a free parameter. Among other things it comprises the separation of real-time and non real-time tasks of baseband processing.

E.g. real-time tasks are:

- Direct user interaction,
- TDMA processing (synchronization) in case this is used,
- Scrambling for conditional access.

E.g. non real-time tasks are:

- Setting of the upstream carrier frequencies and transmitting them to the individual subscribers,
- Commanding the begin and end of a user session as well as receiving wishes from user terminals for beginning and ending a session.

FIG. 8 shows solution 2) with the MCD circuit:

The signal reception is performed in a similar way to solution 1). The difference in this case is that the further processing is done by a quadrature downconversion stage presenting an I and Q component of the IF composite signal. Two sampling A/D - converters follow to digitize the signal being then represented as real and imaginary numbers of n bits width at the outputs. The multicarrier demodulator postconnected is a sufficient fast integrated circuit or a composition of

those presenting at its  $N$  outputs, corresponding to the  $N$  subscribers, the demodulated baseband signals. The further processing is identical to solution 1).

FIG. 9 at last demonstrates the FFT solution 3). The basic idea is to analyse the time - domain received signal according to the laws of fourier transform. The maximum number of subscribers must be known before implementation, i.e. the FFT stage must be tailored to a sufficient number of carriers occurring.

Generally, this FFT unit consists of so-called butterfly networks accepting at their inputs  $N$  complex time-domain samples at word length  $n$  and presenting at their outputs  $N$  complex coefficients at word - length  $n$  describing the input signal in terms of real and imaginary component at a spectral one-of- $N$  location. This is similar to the demodulation representation of the single carrier at the respective location.

The signal is received in a similar manner to the other solutions, i.e. it is first downconverted and pre-filtered as well as amplified. Since the FFT stage needs real and imaginary samples as the MCD does, a quadrature downconversion is provided as well. The grade of the downconversion depends on the A/D converters sampling rate and thus on the technology available. Above all, Shannon's sampling law must be fulfilled describing that a signal with the maximum frequency component at  $f$  must be sampled with  $2f$ . In practice, the quadrature downconversion will be done in a way that the lowest frequency component is near baseband. The highest frequency component of the signal must be then within the range that is technologically feasible by the hardware.

The two rotational switches postconnected to the A/D converters denote the periodic sampling process feeding the sampled signal data into the FTT processing stage with a speed being at least  $1/T = 2f$  when  $T$  is the period between two switch positions and  $f$  is the maximum frequency component of the sampled signal.

The further processing of the outgoing  $N$  complex demodulation products is identical to the other solutions.

The applicability of the MCD and FFT solution depend on the technology available since a large number of upstream carriers corresponds to a large processing bandwidth and thus, speed, which only can previously be presented by advanced ASIC technology. However, if these approaches are feasible for a specific solution, the single demodulator stack solution with its enhanced amount of hardware equipment can be circumvented.

Generally, LMDS is planned to be a system joining one user terminal (set top box) with one outdoor antenna unit. Nevertheless, regarding certain difficult reception scenarios like urban areas, it might be necessary to install one outdoor unit on the roof of a building to supply a plenty of user terminals with downstream signals on one hand and collecting the upstream signals on the other hand.

In the following embodiment, the principle depicted by FIG. 5 is extended to a single user as well as to an SMATV - like application.

First, FIG. 10 shows the compact solution of the single user environment fulfilling the operation requirements of the spectrum depicted in FIG. 3. Indoor - and outdoor unit are interconnected by one single transportation cable carrying the signal composite spectrum from e.g. 100 ... 2150 MHz as an IF layer. Additional command signals are supplied via the DiSEqC™ command set becoming a state-of-the-art standard in modern in-house satellite distribution networks. The indoor unit (set top box) principally consists of a downstream receiver ranging from e.g. 950 - 2150 MHz, a modulator for the upstreams ranging from e.g. 100 - 650 MHz as well as a DiSEqC™ control device for governing the outdoor unit.

The outdoor unit consists of a mixing and downconversion stage for each polarization, H and V, as basically designed in FIG. 5 with a switch for selecting the downstream high - and low band by two DROs (Dielectric Resonator Oscillator) DRO I and II. This is known from the satellite distribution scenario ("Universal LNB") and embodies the fact that the user terminal IF frequency range is limited to 1.2 GHz versus the whole reception IF range is 2.05 GHz.

In this solution example two frequency doublers are added for quadrification of the DRO frequency. The two bands are thus distinguished by applying a different oscillator frequency e.g. of  $f_1 + 4 \times 0.2125 \text{ GHz} = f_1 + 0.85 \text{ GHz}$  to the mixing stages. This is similar to the satellite reception applying  $9.75 \text{ GHz} + 0.85 \text{ GHz} = 10.6 \text{ GHz}$ . The upstream processing is performed as shown in FIG. 5 by exploiting the beacon signal. An emergency shutoff is provided as well as a possible power control by the indoor unit, signalled by the base station, to adopt the radiated power to the geographical location (distance). This is also known from GSM mobile telephone operation. A control device receiving the DiSEqC™ commands is also part of this stage. Suitable filtering is provided for signal selection.

Couplers and power splitters are provided for signal addition / separation for transportation over single cable.

This cable shall be a conventional high-quality satellite IF distribution cable with a length of - depending on cable loss - up to approximately 50 meters.

The multi user terminal application is also a subject of this embodiment: FIG. 6 firstly shows how the system depicted by FIG. 5 can be concentrated and somewhat modified to one block being able to form a sub-element for an outdoor unit in the environment of a house distribution. This block unit shall also be called a Bidirectional Block Converter ("BBC") referring as an analogy to the state-of-the-art LNB (Low Noise Block Converter) being now defined for bidirectional operation. It comprises, in addition to the elements described in FIG. 5, a mixer M5 and an LO at e.g. 2.2 GHz or another suitable frequency to downconvert the upstream IF level carriers at e.g. 2300 ... 2850 MHz running over the house distribution down to the values of e.g. 100 ... 650 MHz demanded in FIG. 5. This is provided to keep the IF frequency range in the cable below 950 MHz free in order to enable terrestrial in house distribution as well. Thus, the BBC has five elementary ports: The two ports at the RF level for the transmit feed TXF and the reception feed RXF as well as the two receive ports for reception in the high and the low band  $RX_H$  and  $RX_L$  at the IF level. Only one additional port for transmission  $TX_x$  or  $y$  for each polarization is necessary.

Using this block, the so-called LMATV BBC (= LMDS MASTERED ANTENNA TELEVISION BIDIRECTIONAL BLOCK CONVERTER) can be constructed: FIG. 11 depicts an in-house distribution with this kind of block converter: Two BBCs, applied to the corresponding antenna feeds, are used to supply the in-house IF level with the eight possible combinations composed of bands and polarizations:

Transmit		Receive	
XPOL	YPOL	XPOL	YPOL
TXband		HighBand	
TXband			LowBand
	TXband	LowBand	
	TXband		HighBand
TXband		LowBand	
TXband			HighBand
	TXband	HighBand	
	TXband		LowBand

Table 1

Because the transmit band is not composed of two particular ranges (TXband only), eight combinations are sufficient and can be carried by six conventional SAT root cables as they are commonly used for two-position - SAT in-house distributions. Four cables are then used for the downstream signals as it is the case in the SAT application: Reception of high and low band as well as x and y polarization. Two additional cables serve for transmission: X and Y polarization of the upstreams. (In the case of a former two SAT in-house distribution with eight cables, two cables can be rejected). Additionally, the SAT roof antenna must be replaced by the LMATV aerial described above.

Since the outdoor unit has now to process a plenty of user terminal return carriers, power control and emergency shutoff have now to be performed by cutting off the individual modulation signal of each user terminal separately by base station command.

A Bidirectional Multiswitch BMS replaces the old unidirectional in-house distribution multiswitches as it is drawn here for two user outlets. This switch comprises connections for the six LMDS and one terrestrial root cables being

looped-through as well as for the user outlets leading to the wall plugs. The user outlet cable carries the composite signal with terrestrial or cable TV signals at e.g. 0.05 ... 900 MHz, SAT IF signals at e.g. 950 ... 2150 MHz and upstreams at eg. 2300 ... 2850 MHz. Inside the switch, these particular signals are coupled out of / into the root cables by suitable couplers. Suitable filters serve for the signal separation being necessary to avoid crosstalk. The DiSEqC™ control is performed in this switch as well, now simulating an LMATV BBC to the indoor unit. In case a command is sent, the BMS configures the corresponding outlet by setting the switches to the demanded positions. Thus, a simple solution with low costs is possible for LMDS replacing the usual SAT distribution.

FIG. 12 shows the RF part of the aerial itself in a schematic manner.

The two BBCs supply and achieve their signals via their transmit ports  $TXF_{x/y}$ , as well as via their receive port connections  $RXF_{x/y}$  by suitable 40 GHz waveguides. The IF ports  $TX_{x/y}$  and  $RX_{H/L/x/y}$  shall be realized with suitable coaxial cable connections. Transmit and receive paths in the feed combination system must be sufficiently decoupled to avoid end-around oscillations within the BBC - aerial system.

Claims

1. A base station for broadcasting or re-broadcasting of TV and/or audio and/or data signals, said station comprising:

means for transmitting downstream signals from said base station to at least one user terminal;

means for receiving upstream signals transmitted from said at least one user terminal;

means for transmitting a high-precision beacon signal as reference signal for the generation of said upstream signals.

2. A base station according to claim 1, wherein said base station forms a part of an LMDS provider-site distribution system, and wherein said base station of said system further comprises one or a combination of the following:

means for baseband processing, modulation, and power combination of downstream carriers and/or

means for block conversion and power amplification of downstream carriers as well as demodulation of arbitrary numbers of upstream carriers;

means for station management;

means for controlling interactively communication frequencies and power;

means for communication with adjacent cells and a remote service provider;

means for communication with other networks like satellite and/or cable.

3. A base station according to one of the preceding claims, said base station comprising:

an upstream reception system with a stack of single demodulators comprising:

means for low noise amplification;

means for downconverting from RF to a first IF level;

means for power splitting;

a downconversion mixer bank for individual upstream carrier downconversion;



means for generating individual LO frequencies;

means for filtering;

a demodulator bank;

means for baseband processing to exploit the incoming demodulated upstream data.

4. A base station according to claim 3, further comprising means for arbitrarily configuring the demodulation mode.

5. A base station according to one of claims 1 or 2, further comprising:  
an upstream reception system with a multicarrier demodulator system comprising:

means for low noise amplification;

means for downconversion from RF to a first IF level;

means for quadrature downconversion;

means for sampling and for A/D-conversion for subsequent signal processing;

means for analytical multicarrier demodulation signal processing;

means for baseband processing.

6. A base station according to one of claims 1 or 2, said base station comprising:

an upstream reception system with a FFT demodulation system comprising:

means for low noise amplification;

means for downconversion from RF to a first IF level;

means for quadrature downconversion;

means for sampling and for A/D-conversion for subsequent signal processing;

means for analytical FFT signal processing;

means for baseband processing.

7. A user-site reception system for receiving TV and/or audio and/or data signals transmitted from a base station, said system comprising:

means for receiving downstream signals transmitted from a base station;  
means for generating upstream signals to be transmitted to said base station using a high-precision signal which can be transmitted from said base station as a reference.

8. A user site reception system according to claim 7, wherein said system is a reception-interaction system for a LMDS system, said reception system further comprising:

means for command reception from a base station;  
means for user interaction with said base station.

9. A system according to one of claims 7 or 8, said system comprising:  
means for exploiting the high-precision beacon signal, said mixer comprising:

frequency processing means for upconverting the upstreams, given by modulator IF outputs, without any influence of parasitic phase noise and drift generated by receiver located conversion LOs;

means for downconversion of downstreams;  
means for suitable filtering of frequency bands.

10. A reception system according to one of claims 7 to 9, wherein said means for exploitation of a high-precision beacon signal comprises:

means for downconverting said beacon signal using a first local oscillator frequency;

means for upstream modulation of said upstream signal onto said downconverted signal;

means for upconverting said upstream modulated downconverted signal using said first local oscillator frequency.

11. A reception system according to one of claims 7 to 10, comprising:  
at least one upstream signals generating means according to one of claims 7 to 10;

means for processing of polarizations and frequency bands for up- and downstreams;

means for connecting to an IF frequency level to be connected to an in-house distribution infrastructure;

means for connecting to an RF frequency level to be connected to a radiator/receptor;

means for power amplification.

12. A single user outdoor unit, comprising:

at least one upstream signal generating means according to one of claims 7 to 11;

switching means for switching between frequency bands and polarizations for downstreams and between polarizations for upstreams;

means for connecting to a IF frequency level to be connected to an indoor unit.

13. A unit according to claim 12, further comprising means for remote control (e.g. DiSEqC™) for functions including at least power control and emergency shutoff.

14. An in-house distribution component, comprising:

switching means for switching the connection between individual user indoor units and the outdoor unit.

15. An in-house distribution component according to claim 14, wherein said switching means comprises means for bidirectional switching between the user indoor units and the outdoor unit.

16. An in-house distribution component according to claims 14 or 15, wherein said unit further comprises:

means for controlling the switching in response to signals received from an indoor unit;

means for connecting to an IF frequency level to be connected to an indoor unit.

17. An indoor unit to be connected to an outdoor unit according to claim 12 or 13 or to an in-house distribution component according to one of claims 14 to 16, said indoor unit comprising:

- receiving means for the reception of downstream signals;
- demodulation means for demodulating the downstream signals;
- modulation means for generating an upstream carrier;
- control means for generating switching commands.

18. An indoor unit according to claim 17, further comprising one of the following:

- means for exploiting base station commands to allocate upstream carriers and/or power;
- means to control or shut off the upstream carrier power.

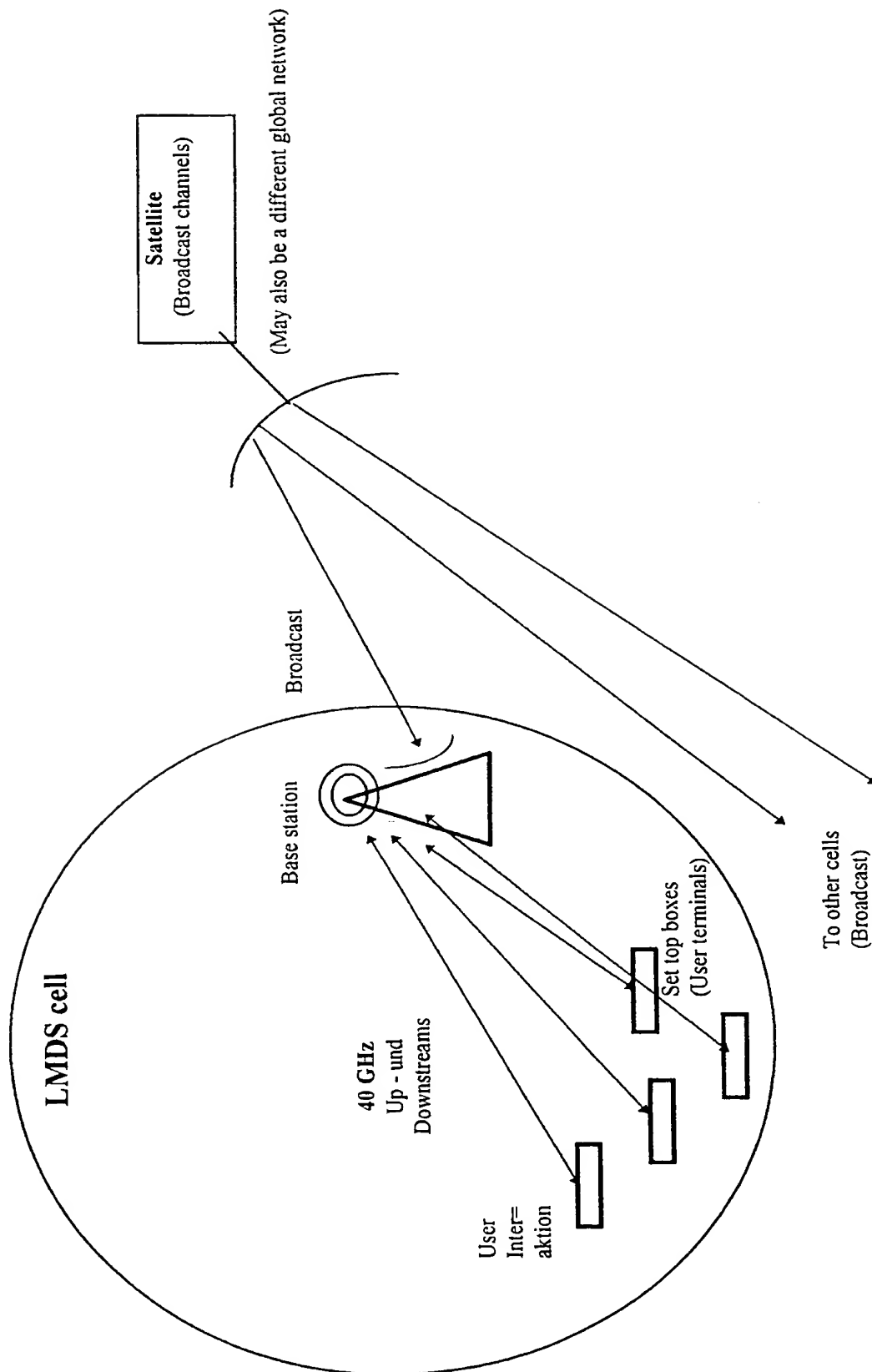


Fig. 1

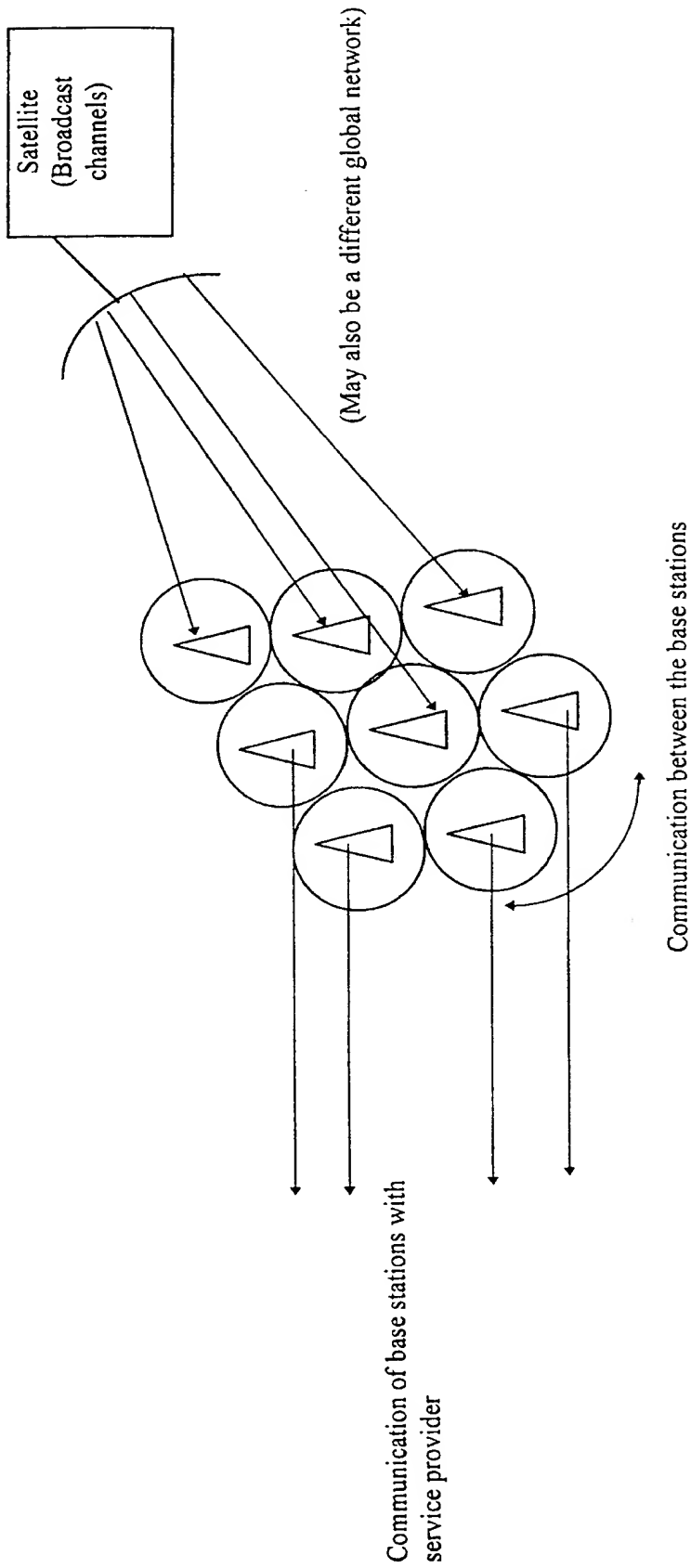
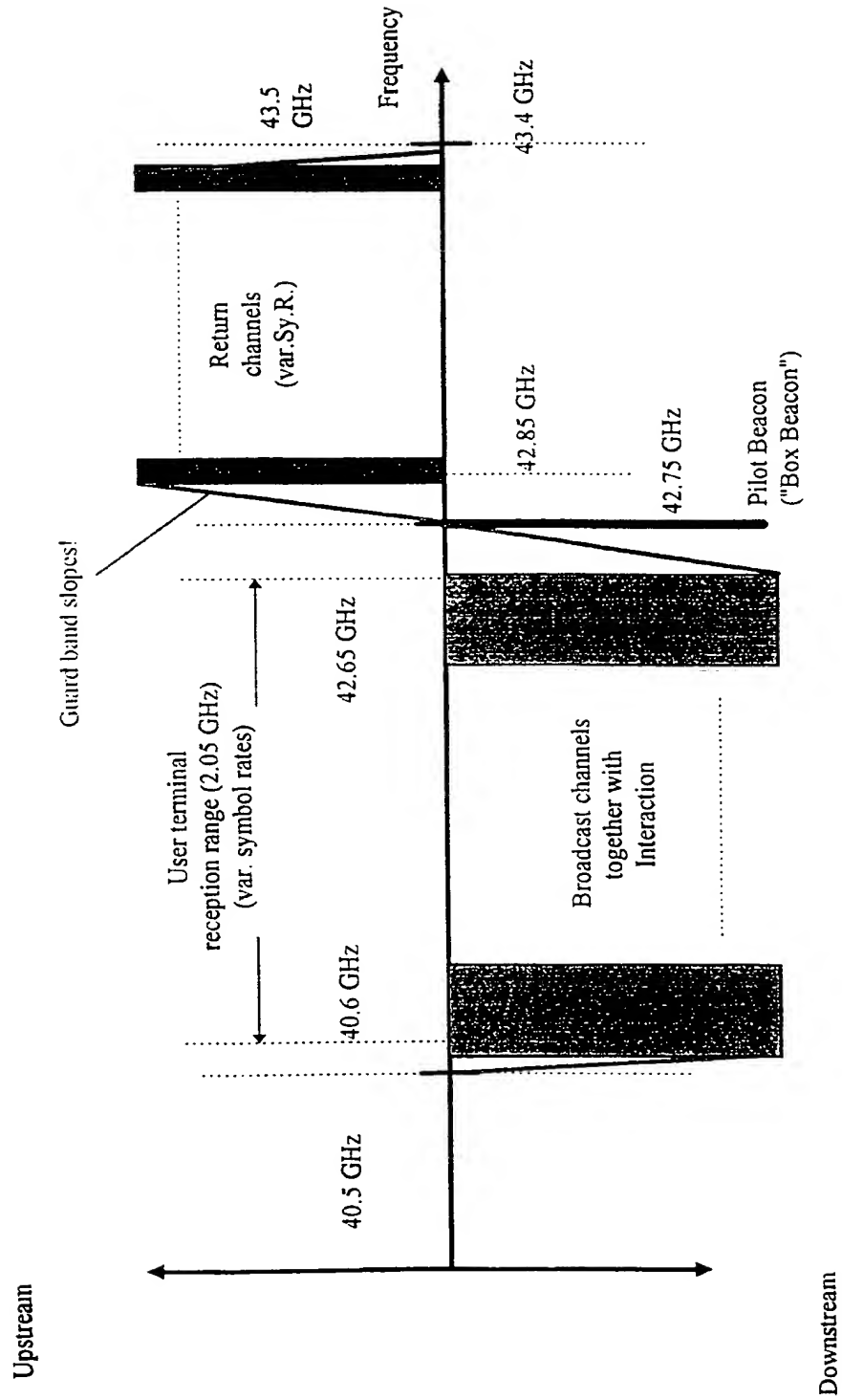
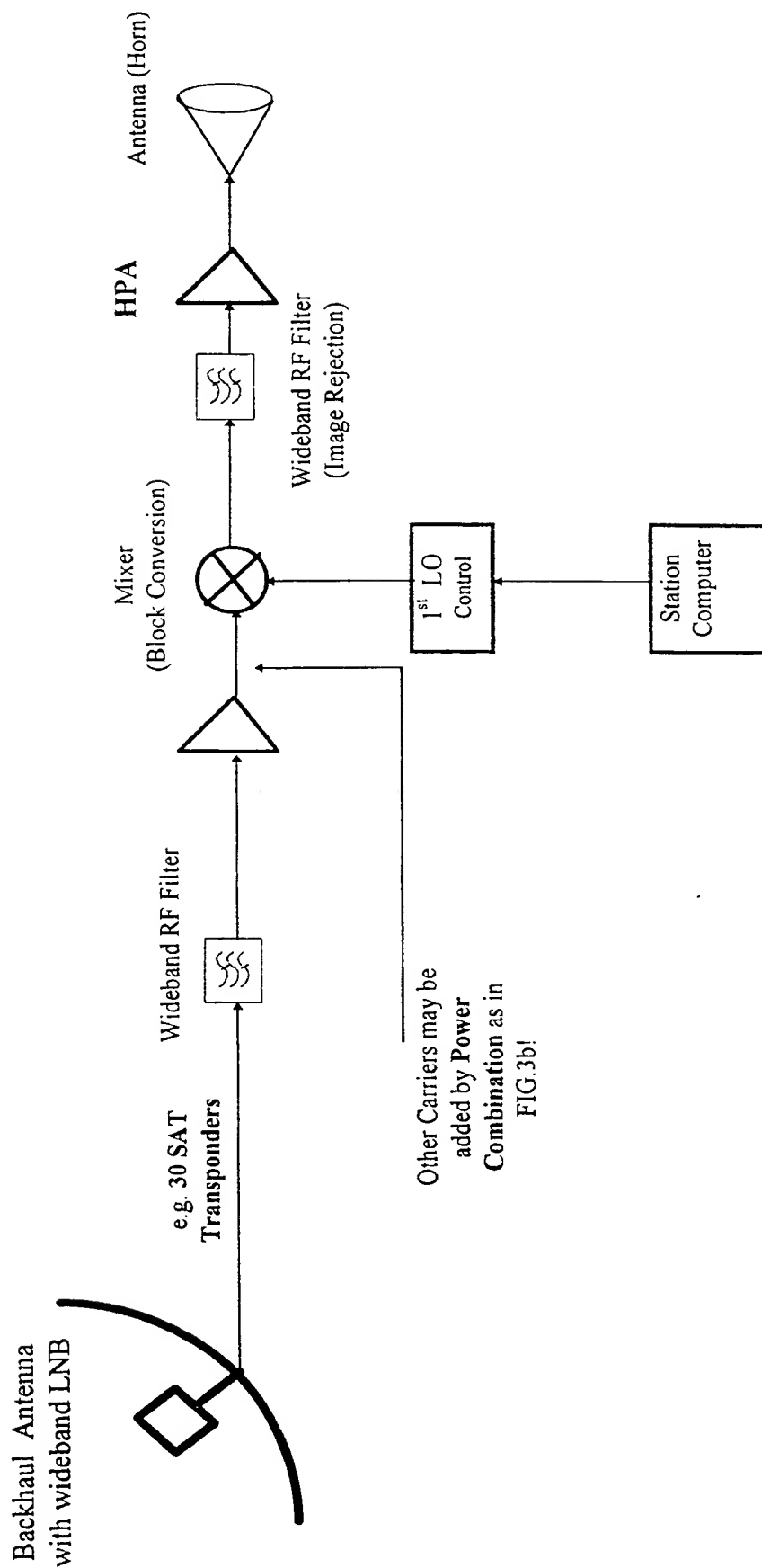


Fig. 2

**Fig. 3**

Fig. 4a



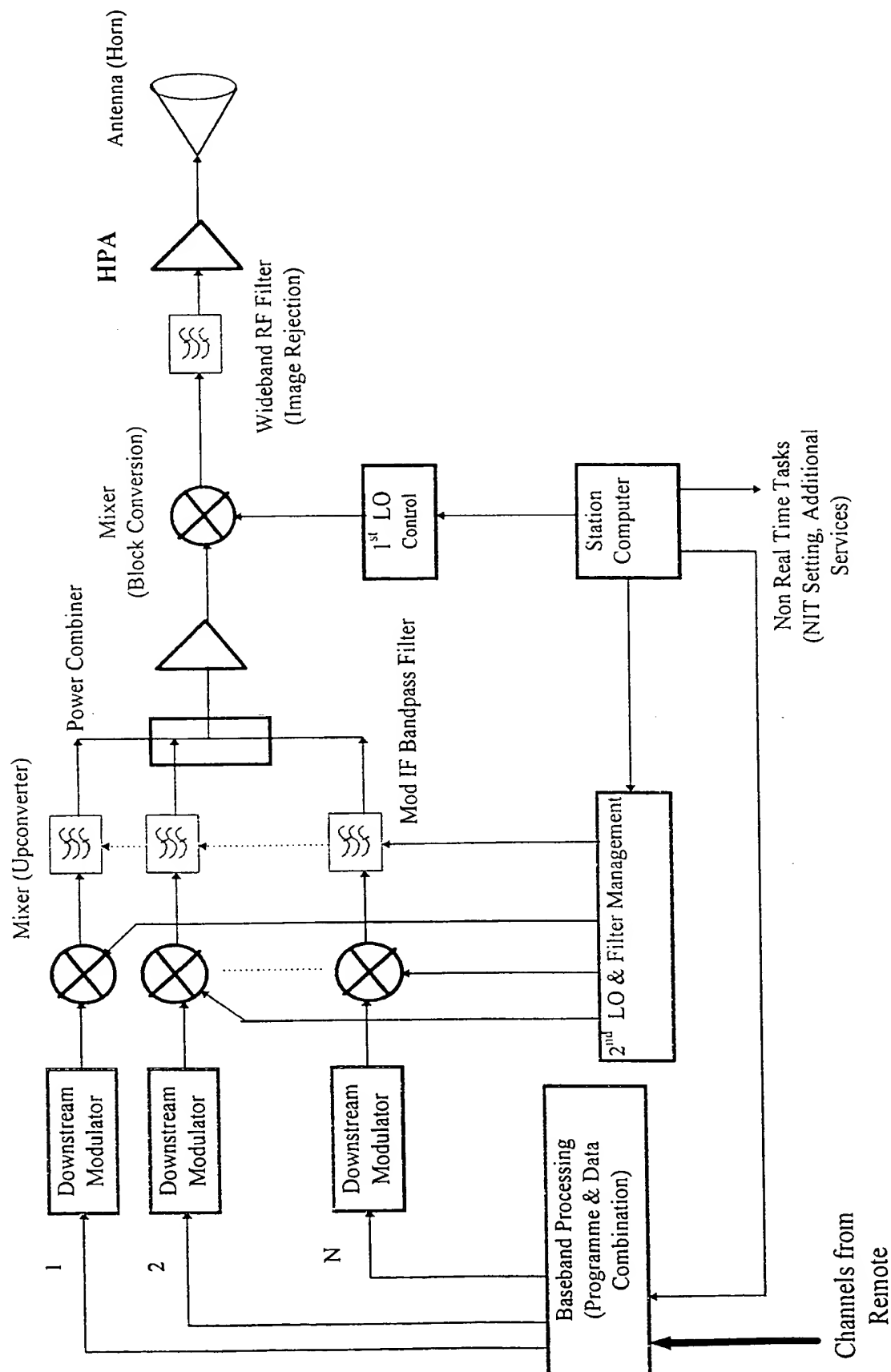


Fig. 4b

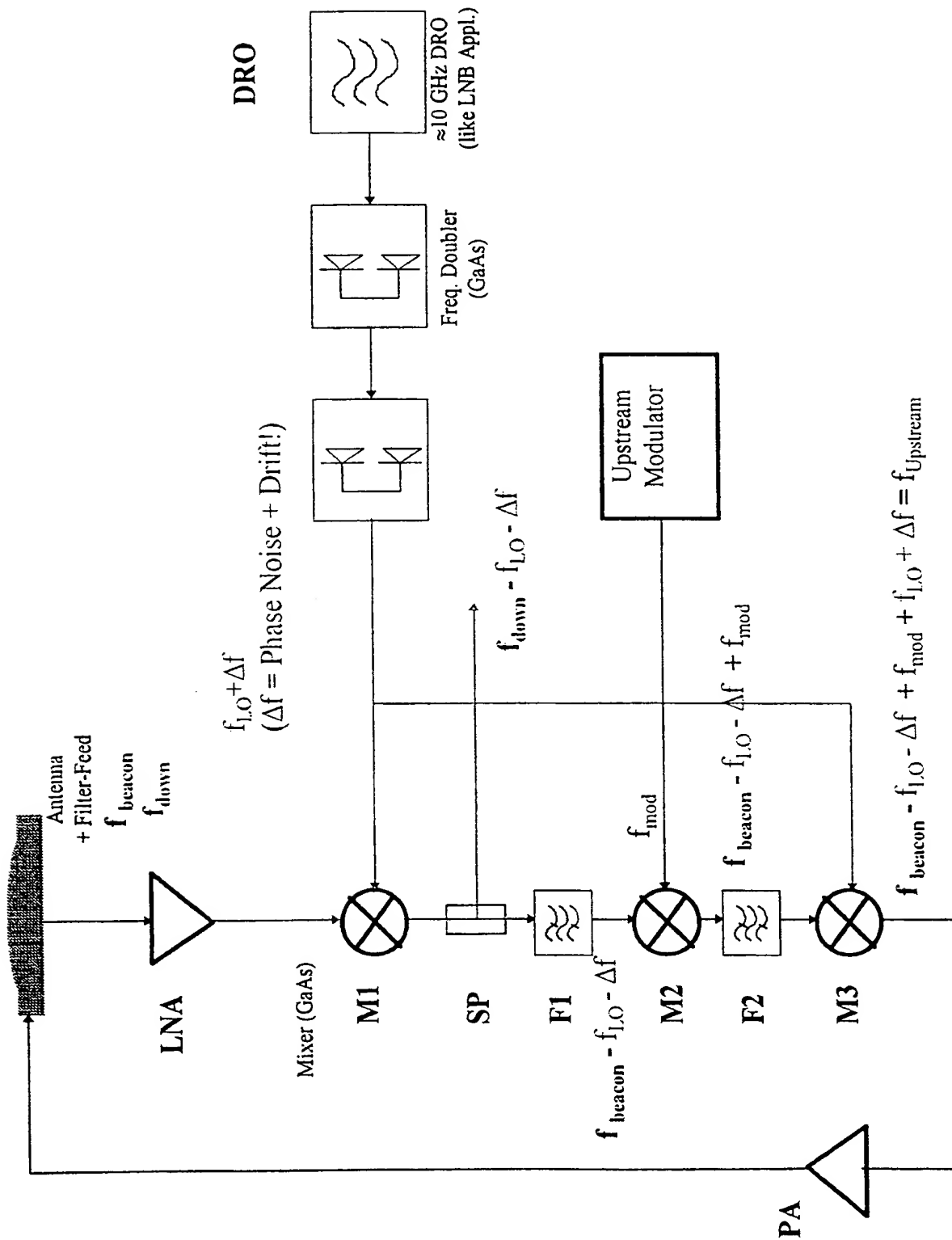
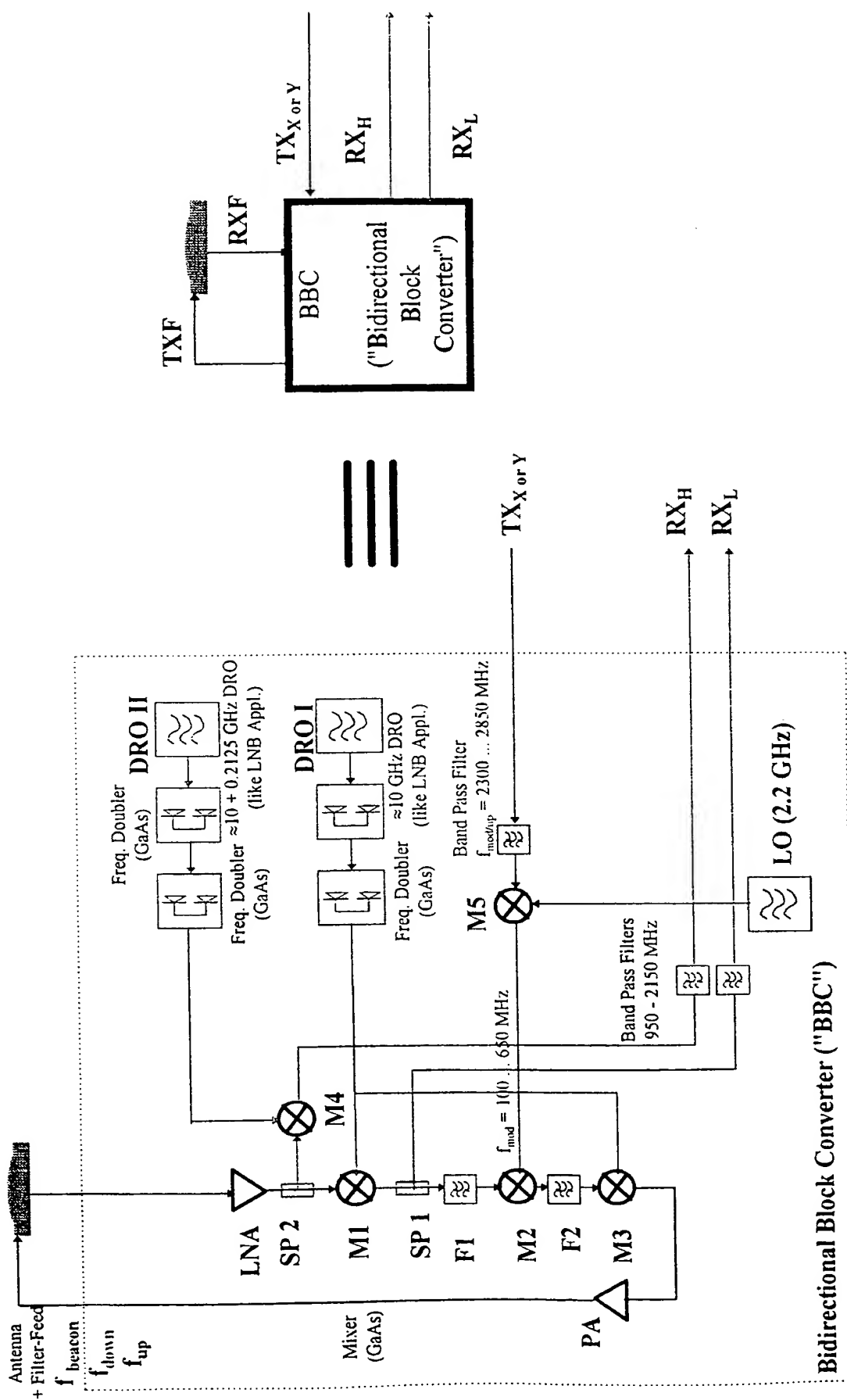


Fig. 5



**Fig. 6**

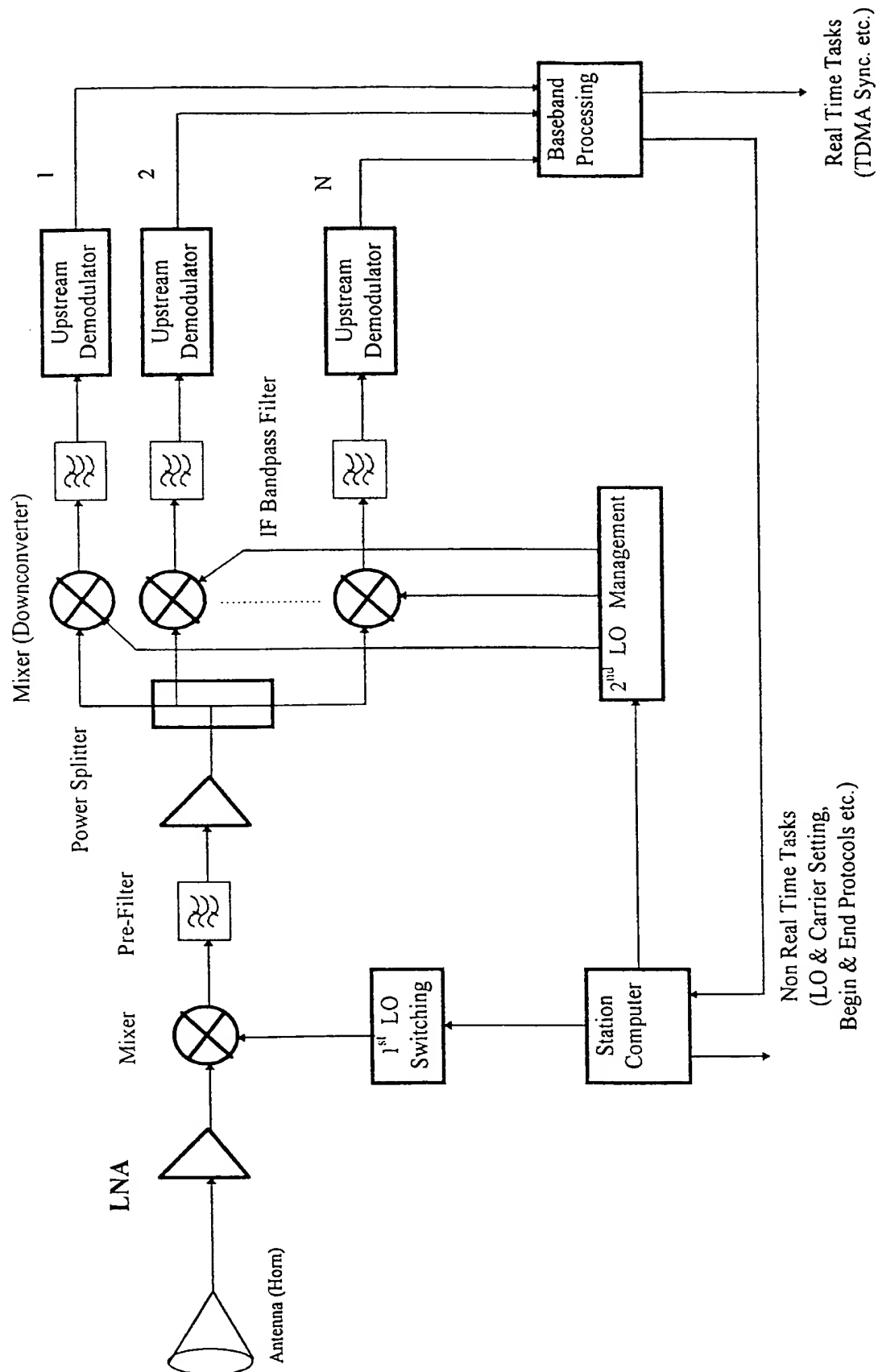


Fig. 7

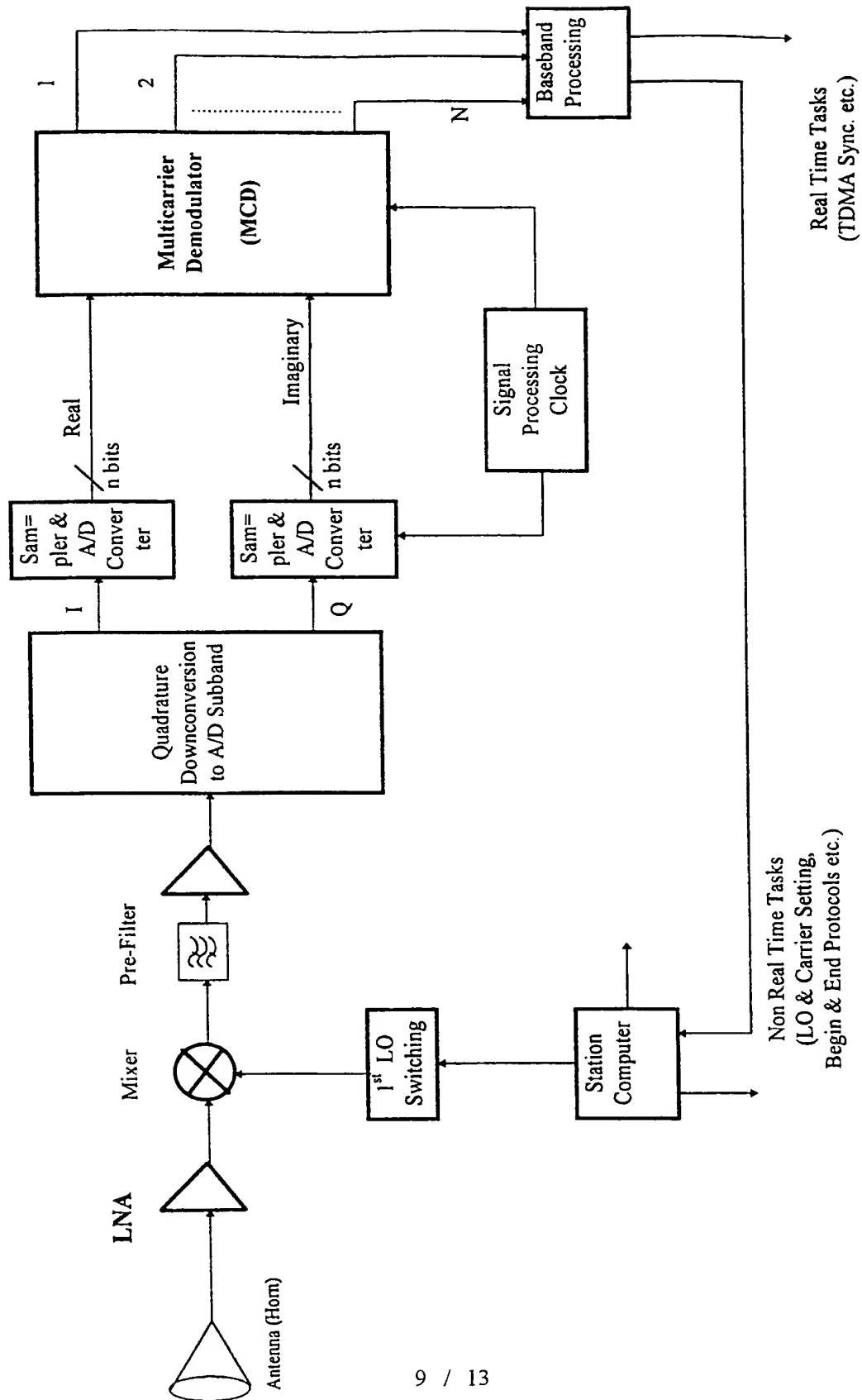


Fig. 8

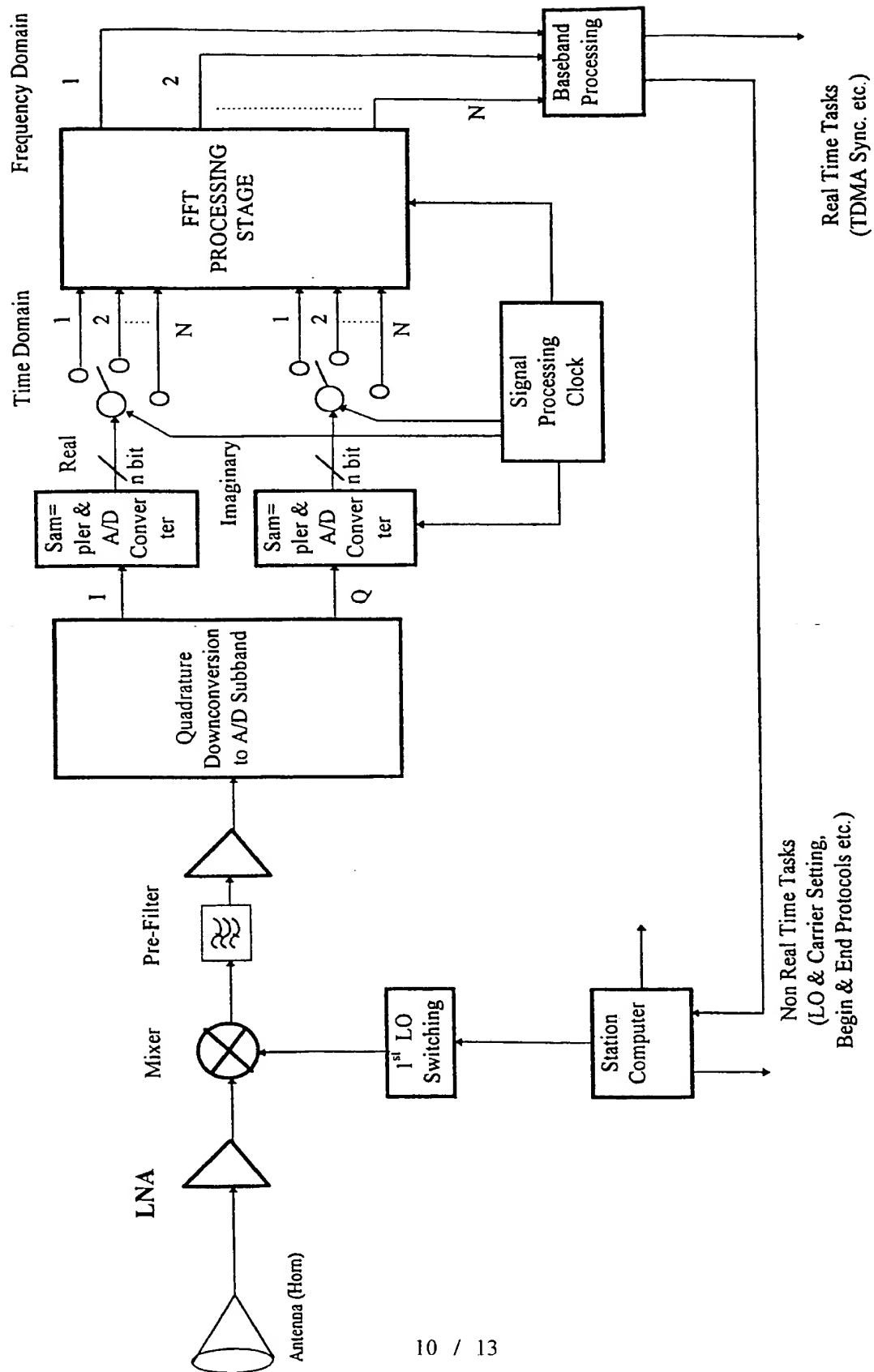


Fig. 9

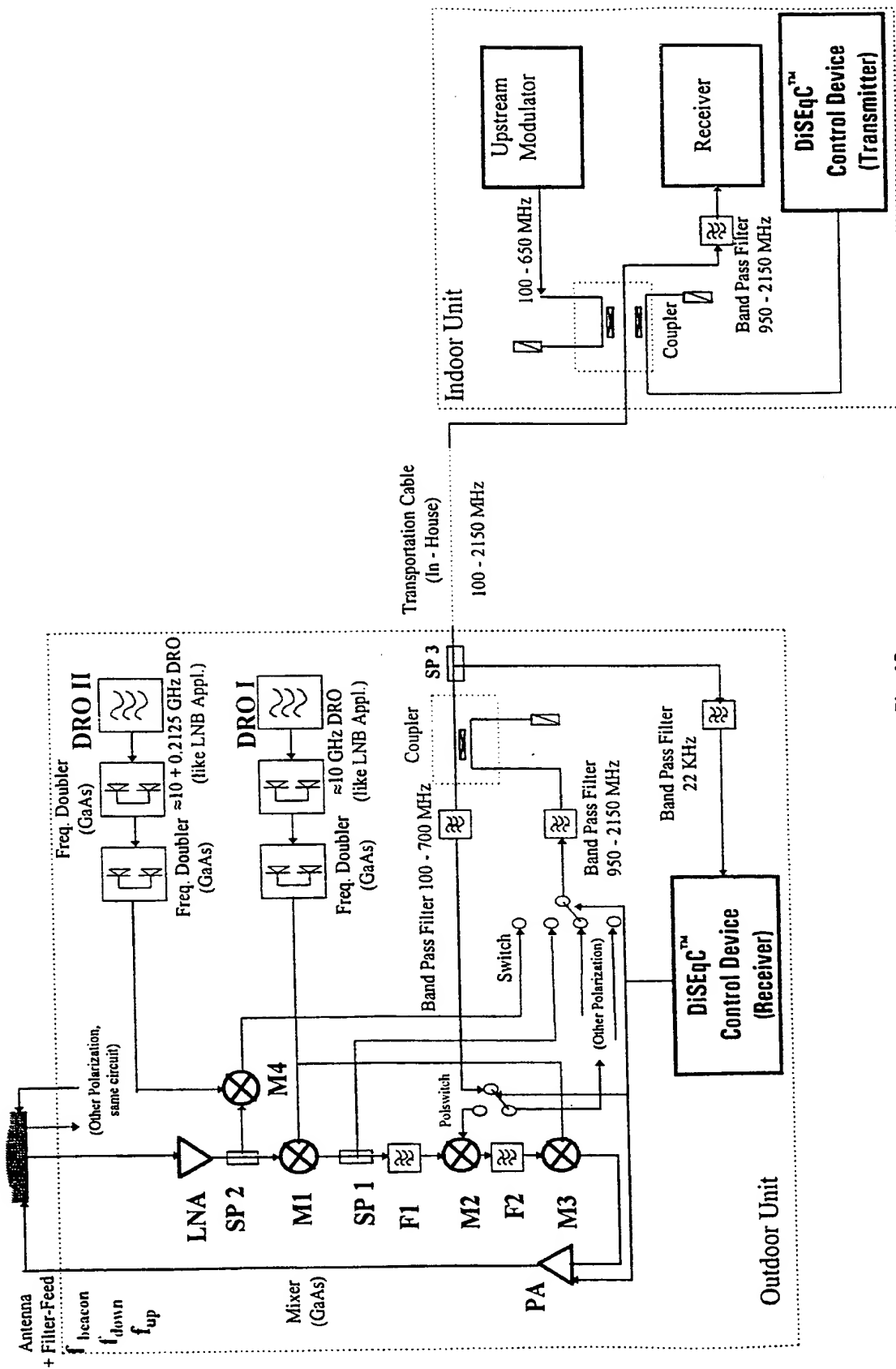
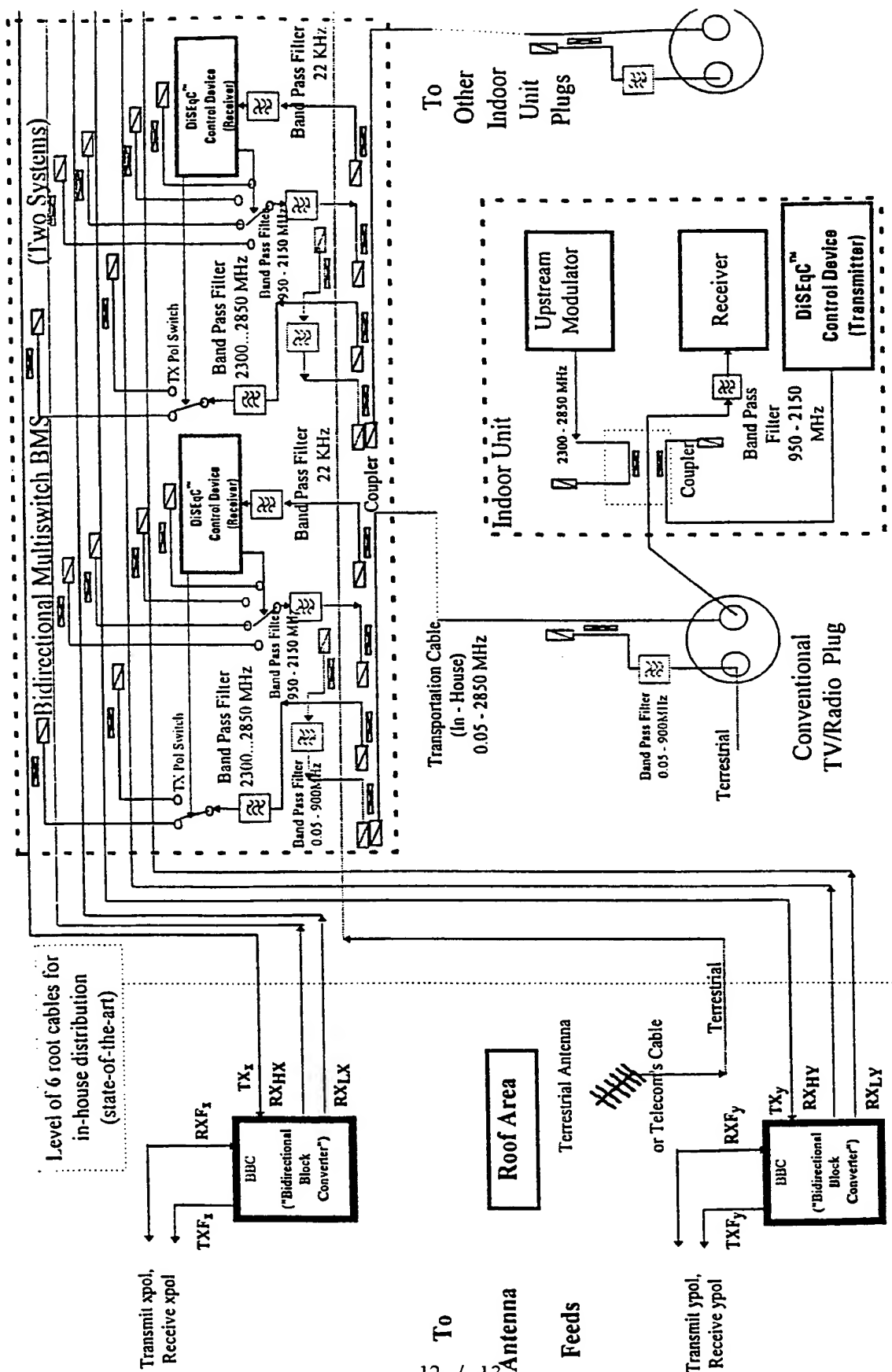


Fig. 10



**Fig. 11**



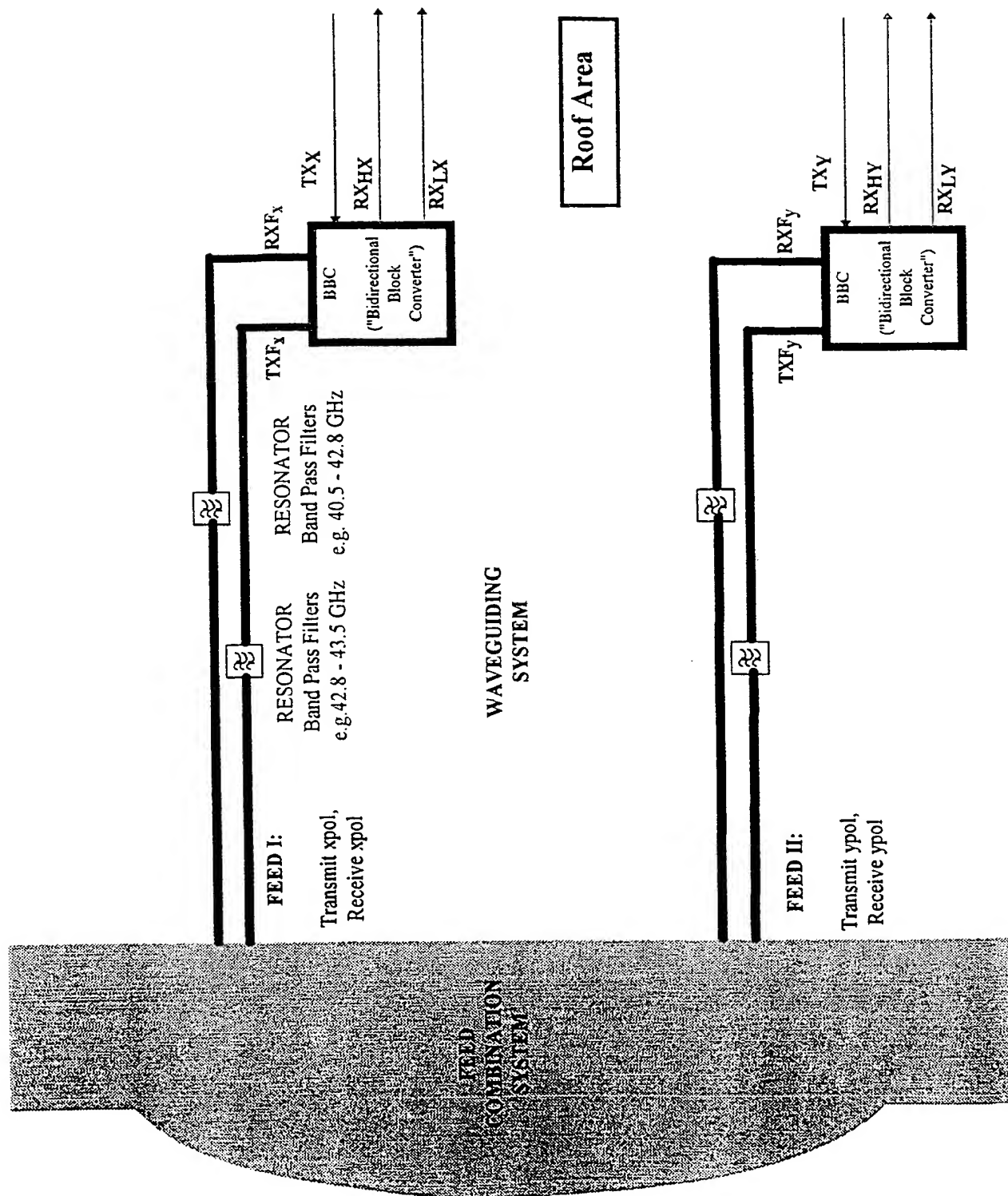


Fig. 12

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 99/02424

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 H04H1/00 H04H9/00 H04N7/173

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 H04H H04Q H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P, X	EP 0 851 618 A (TEXAS INSTRUMENTS INC) 1 July 1998 (1998-07-01) abstract column 5, line 42 - line 55 column 6, line 11 - line 14 column 7, line 34 - column 47 claims 7,9 figures 3-6	1,7,9, 10,12
X	EP 0 713 347 A (AT & T CORP) 22 May 1996 (1996-05-22) abstract column 3, line 49 - column 4, line 7 column 14, line 11 - column 52 claim 1	1,7
A	figures 1-4	2,3



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

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Date of the actual completion of the international search

24 August 1999

Date of mailing of the international search report

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# INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 99/02424

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 97 48196 A (BELLSOUTH CORP) 18 December 1997 (1997-12-18) abstract page 8, line 24 - line 27 page 11, line 9 - line 16 page 12, line 2 - line 9 claims 1,6	12,14
A	figures 1,3-5	1,7,11
A	WO 97 48191 A (BUGAS DMITRY ;GRAVES H DAVID (CA); BROADBAND NETWORKS INC (CA); SC) 18 December 1997 (1997-12-18) abstract page 20, line 20 - line 35 claim 33 figures 1-3,6	1-3,7, 11,12
A	WO 97 21276 A (STANFORD TELECOMM INC) 12 June 1997 (1997-06-12) abstract claim 1 page 9, line 3 - page 10, line 8 page 37, line 19 - page 40, line 28 figures 1,17-21	1,5,7
A	EP 0 825 775 A (PHILIPS ELECTRONICS NV) 25 February 1998 (1998-02-25) abstract column 3, line 32 - line 48	12,13

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/EP 99/02424

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0851618	A	01-07-1998	JP 10200473 A	31-07-1998
EP 0713347	A	22-05-1996	US 5570355 A	29-10-1996
			CA 2162611 A	18-05-1996
			CN 1151094 A	04-06-1997
			JP 8251237 A	27-09-1996
WO 9748196	A	18-12-1997	US 5867485 A	02-02-1999
			AU 3482497 A	07-01-1998
			CA 2257978 A	18-12-1997
			EP 0906672 A	07-04-1999
WO 9748191	A	18-12-1997	AU 3021997 A	07-01-1998
			CA 2257967 A	18-12-1997
			EP 0904639 A	31-03-1999
WO 9721276	A	12-06-1997	US 5809431 A	15-09-1998
			AU 1078197 A	27-06-1997
			BR 9611926 A	30-03-1999
			CA 2237463 A	12-06-1997
			CN 1214815 A	21-04-1999
			EP 0873594 A	28-10-1998
EP 0825775	A	25-02-1998	FR 2752502 A	20-02-1998
			JP 10093888 A	10-04-1998